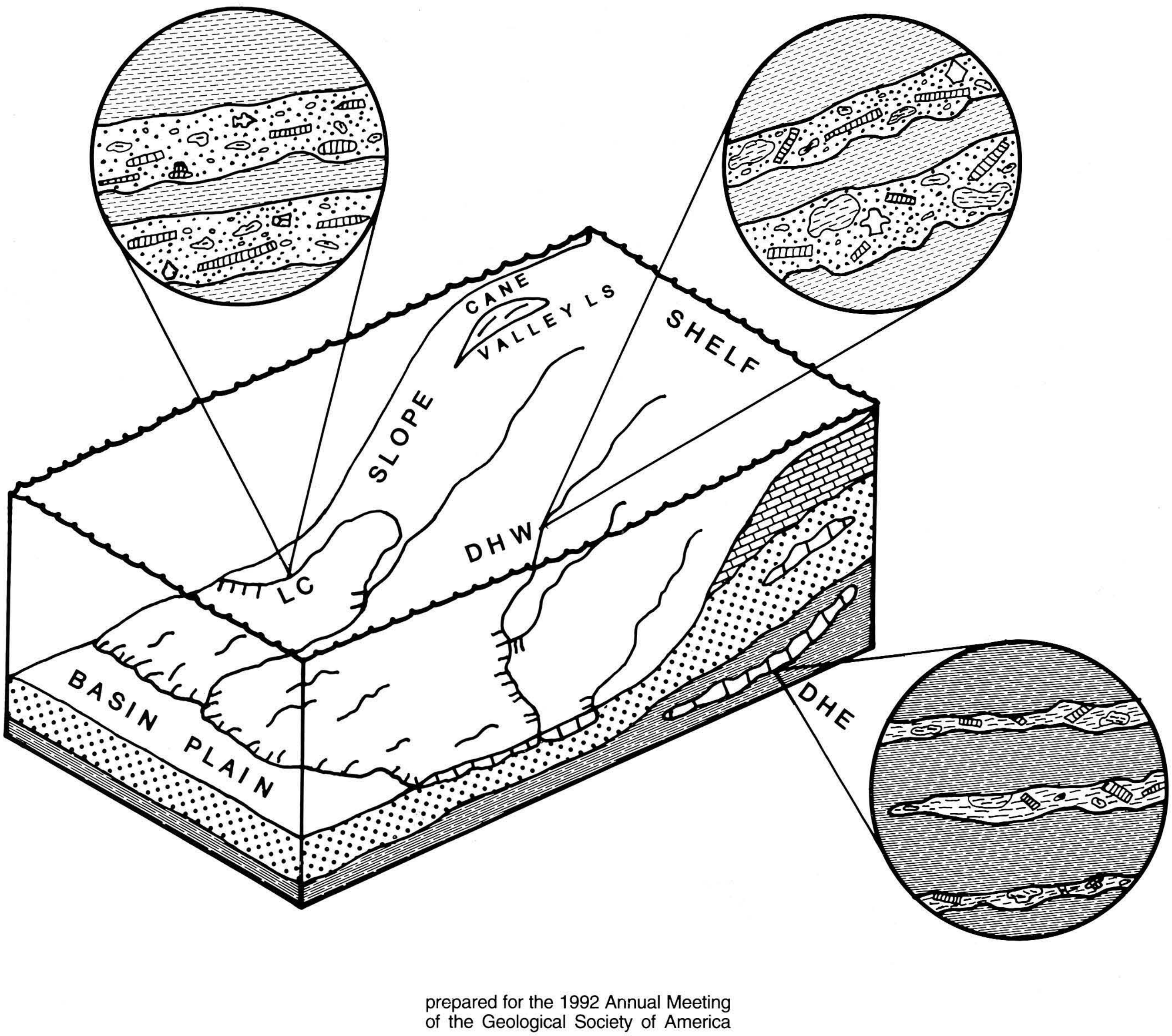
MISCELLANEOUS REPORT NO. 4

FORT PAYNE CARBONATE FACIES (MISSISSIPPIAN) OF SOUTH-CENTRAL KENTUCKY

by

David L. Meyer and William I. Ausich



prepared for the 1992 Annual Meeting
of the Geological Society of America

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Field Trip 14 for the Annual Meeting
of the Geologial Society of America
Cincinnati, Ohio
October 26-29, 1992

Columbus
1992

OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY

Typesetting and layout:
Mad Hungarian Printing & Graphics, Inc.
Cartographic assistance:
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Cover illustration:
Model of clinoform deposition for the Fort Payne Formation. See figure 7.

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FORT PAYNE CARBONATE FACIES (MISSISSIPPIAN) OF SOUTH-CENTRAL KENTUCKY

by
David L. Meyer
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INTRODUCTION

This field trip offers an unparalleled opportunity to examine some of the most extensive and best exposed Lower Mississippian strata in eastern North America. This opportunity has come about as a result of two unique circumstances: the creation in 1950 of Lake Cumberland, with over 1,200 miles of shoreline offering continuous outcrop at low water levels; and the geologic mapping of Kentucky by the U.S. Geological Survey (USGS) and Kentucky Geological Survey in the 1960's and 1970's. This mapping greatly facilitated study of Fort Payne carbonates by designation of carbonate bodies on 7.5-minute quadrangles as "reef limestone."

Our interest in the Fort Payne Formation began with a 1978 field trip to the Cumberland Saddle region by Lewis and Potter in which it was pointed out that "reef limestone" as mapped includes several distinct carbonate facies, both autochthonous and allochthonous. Of particular interest were carbonate-mud mounds compared to Waulsortian facies known elsewhere in the Lower Mississippian. We also recognized a rich, unexplored fossil content in these carbonates that had great potential for helping to understand Fort Payne deposition. During the past 10 years we and several graduate students have made an extensive study of fossil distribution, taphonomy, and facies characteristics of Fort Payne carbonates along the shores of Lake Cumberland, Dale Hollow Reservoir, and nearby areas (fig. 1). The purpose of this field trip is to examine both autochthonous and allochthonous carbonate facies of the Fort Payne along the shores of Lake Cumberland and to present paleontologic, taphonomic, stratigraphic, and sedimentologic evidence pertaining to their origins.

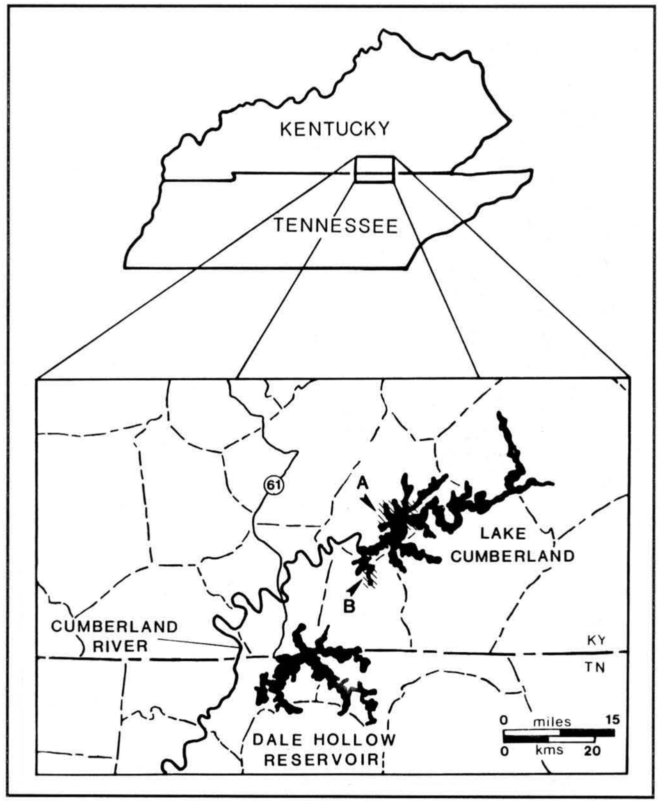

Figure 1. Location of field-trip areas in Kentucky and Tennessee. Detailed maps of areas A and B shown in figures 8 and 21.

FORT PAYNE FORMATION

The Fort Payne Formation is a lithologically diverse and widely distributed Lower Mississippian stratigraphic unit recognized from Alabama and Georgia northward through Tennessee and Kentucky to the subsurface of the Illinois Basin. In the south, the Fort Payne is known as the Fort Payne Chert for its high chert content, but in the Cumberland Saddle region of south-central Kentucky and north-central Tennessee the unit contains a mixture of carbonates and siliciclastics. On the basis of subsurface mapping, Lewis and Potter (1978, fig. 7) recognized five major regional facies in the Fort Payne across central Kentucky and adjacent states. In the field-trip area, a carbonate-buildup facies is developed which contains various types of carbonate bodies enclosed in siltstone and shale. Carbonate bodies have been recognized in this area since at least the 1920's (Butts, 1922) and comprised the Greasy Creek Facies of Klepser (1937). It was not until extensive exposures along the shorelines of Lake Cumberland and Dale Hollow Reservoir became available that the heterogeneous character and distribution of Fort Payne carbonates could be fully appreciated. Understanding this lithologic heterogeneity is one of the many challenging problems posed by the Fort Payne.

The most distinctive feature of the Fort Payne in Kentucky is its abrupt thinning along a regular zone, known as the "Borden Front" (Peterson and Kepferle, 1970; Sedimentation Seminar, 1972), about 10 miles wide, striking about N45°W, less than 20 miles northeast of the Lake Cumberland field trip area. Along this zone, which extends into Indiana, the Fort Payne thins against a massive wedge of deltaic siltstone and shale comprising the Borden Formation (fig. 2). The Borden wedge and the Fort Payne are separated along the Borden Front by the thin, glauconitic Flo, glauconitic Floyds Knob Bed, indicative of a hiatus in clastic deposition when Borden deltaic sedimentation shifted to the northwest. Renewed sedimentation of the Fort Payne occurred along the abandoned Borden delta slope. Accordingly, Fort Payne deposition was time-transgressive and clinoform in character along the Borden Front (Peterson and Kepferle, 1970; Pryor and Sable, 1974). The maximum thickness of the Fort Payne in the study area, about 90 m, is comparable to that of the adjacent Borden, and provides an indication of minimum depth of the starved basin into which Fort Payne sediments were first introduced.

Fort Payne deposition, as well as the introduction of the Borden clastics, took place entirely during the late Osagean, as indicated by several lines of faunal evidence. First, the conodont *Gnathodus texanus* Roundy occurs in Fort Payne carbonate facies and is characteristic of the late Osagean *Gnathodus texanus* Zone of Lane and others (1980) which is coeval with the Keokuk Limestone of the Mississippi Valley North American standard section for the Mississippian. Second, at least 16 pelmatozoan echinoderm species from

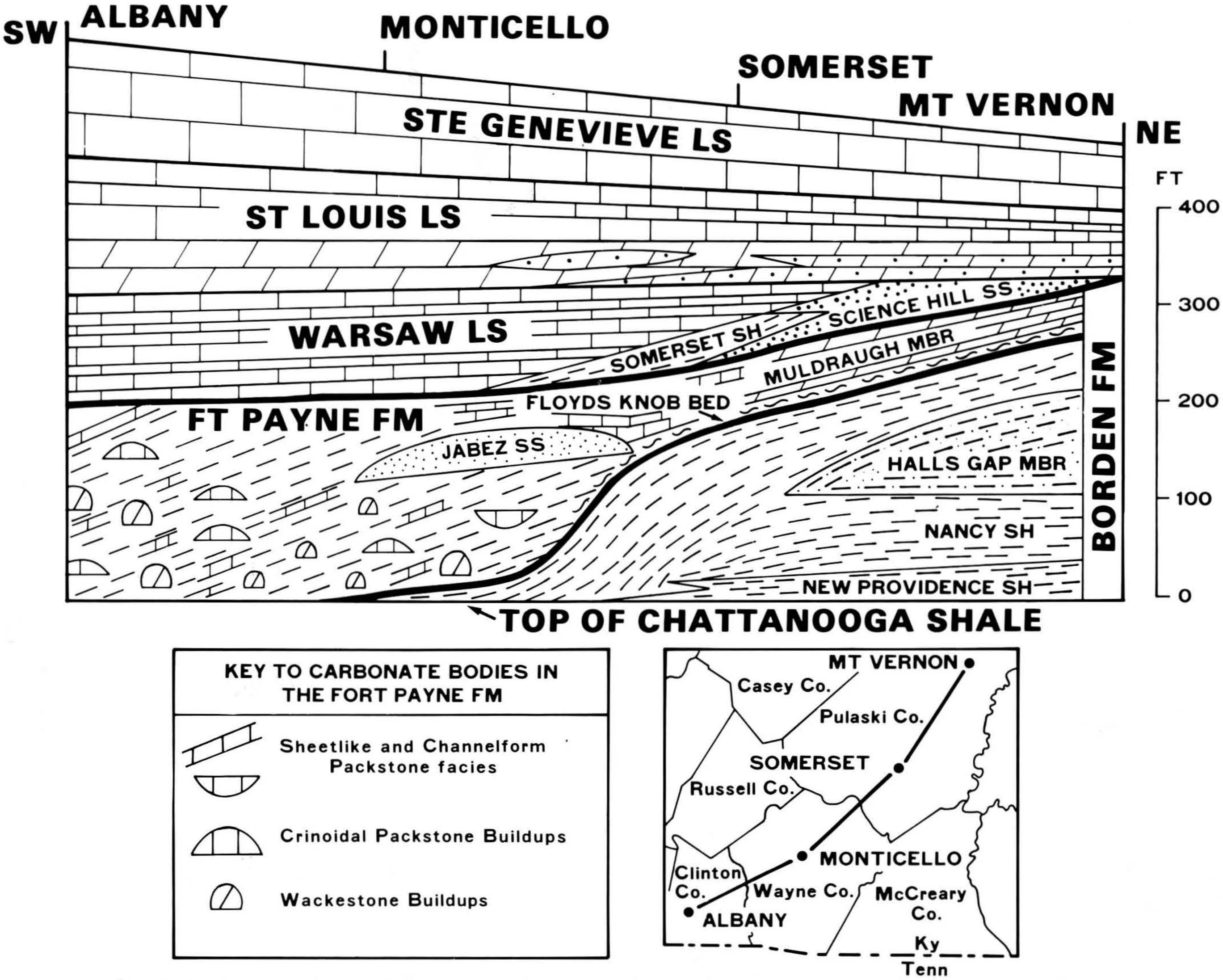

Figure 2. Diagrammatic stratigraphic cross section showing relationships between the Fort Payne and Borden Formations and overlying units. Section parallels Fort Payne depositional dip. Modified from Lewis and Potter (1978).

the Fort Payne also occur in the Keokuk or its equivalents. Within the Fort Payne, the fossiliferous green shale contains a diverse macroinvertebrate fauna very similar to that of the Button Mold Knob fauna of the New Providence Shale Member of the Borden Formation in north-central Kentucky. The Button Mold Knob fauna was determined by Kammer (1982, 1984) to be age-equivalent to the Keokuk Limestone.

FORT PAYNE LITHOFACIES

We recognize seven distinct lithofacies in the field trip area around Lake Cumberland (Ausich and Meyer, 1990). Siliciclastic facies include the "background" siltstone facies composing the bulk of the Fort Payne, the Jabez Sandstone Member, and the fossiliferous green shale facies. Carbonate facies, mapped collectively as "reef limestone" on the USGS Geologic Quadrangle Series (GQ) maps, include wackestone buildups (Waulsortian facies), crinoidal packstone buildups, sheetlike packstones, and channelform packstones. Characteristics of these facies are summarized in table 1 and figure 3. Examples are shown in figures 4, 9, 13, 16, and 19. More detailed information is available in Ausich and Meyer (1990).

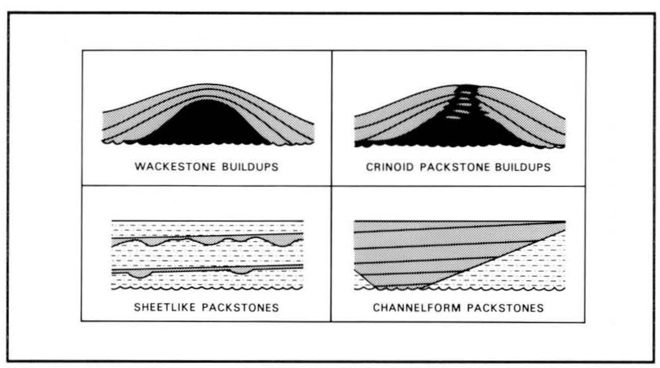

Figure 3. Diagrammatic cross sections illustrating the geometry of carbonate facies and enclosing strata, as displayed in Lake Cumberland shoreline exposures. Dot pattern=carbonates, black=green shale, dot-dash pattern=siltstone. Diagrams not to scale, vertically exaggerated. From Ausich and Meyer (1990); used by permission of the Geological Society of America.

TABLE 1 — *Fort Payne Formation lithofacies, Lake Cumberland, Kentucky*

FACIES	DOMINANT LITHOLOGY	BEDDING	GEOMETRY	INTERPRETATION	LOCALITIES*
Siltstones	Siltstone	Thin to massive	Sheetlike	Clinoform deposition	Widespread
Sandstones	Med.-grained sandstone	Planar	Lenticular	Basin-margin	HC
Green shales	Green shale, packstone	None	Domal, flanking carbonates	Autochthonous, trapping, baffling	PH, HC, OB
Wackestone buildups	Wackestone	Massive, thickens toward flanks	Domal, drapes over shale core	Autochthonous, Waulsortian mounds	PH, HC, OB,RO
Packstone buildups	Crinoidal packstone	Massive, thickens toward flanks	Broadly domal, flat top	Autochthonous, crinoidal mound	CS, GC
Sheetlike packstones	Crinoidal packstone	Graded, lenticular to tabular	Sheetlike	Allochthonous, distal turbidites, debris flows	WC/CC, IC
Channelform packstones	Crinoidal packstone	Graded, thin, planar	Channel-fill	Allochthonous, channel-fill turbidites	WCS

* Locality codes as in figures 8, 21.

COMPARATIVE ECHINODERM TAPHONOMY

Pelmatozoan echinoderms are the dominant fossil constituents of Fort Payne carbonates. Pelmatozoan preservation ranges from complete specimens with attached arms and columns to disarticulated calyx plates and columnals. Because of the overwhelming abundance of pelmatozoans in Fort Payne carbonates, we conducted a taphonomic analysis comparing pelmatozoan preservational style among the carbonate facies.

Along with other organisms having multi-element skeletons, pelmatozoans provide potentially sensitive indicators of post-mortem depositional processes because differential disarticulation can be correlated with exposure time and degree of transportation prior to final burial (Brett and Baird, 1986). Field and laboratory experiments using Recent comatulid crinoids show that, in the absence of rapid burial, specimens disarticulate rapidly within a few days after death (Blyth Cain, 1968; Meyer, 1971; Liddell, 1975; Meyer and Meyer, 1986). Experiments on the disarticulation rates of Recent stalked crinoids indicate that stalks can remain articulated longer than crowns (D. L. Meyer and T. Oji, unpublished work). Complete fossil crinoids with articulated arms indicate rapid burial, and increasing disarticulation reflects more gradual burial (Lane, 1971; Brett and Baird, 1986). In most cases, intact crinoids with arms and stalk attached indicate burial in proximity to the living site, although, under certain circumstances, complete specimens can undergo transportation (Meyer, Ausich, and Terry, 1989).

The preservational condition of crinoids collected from Fort Payne facies was assessed by ranking each specimen along a taphonomic scale (fig. 5, table 2). Frequencies of specimens in each taphonomic category were determined for each facies and the results are shown in figure 6.

TABLE 2—*Preservational categories used in taphonomic analysis of Fort Payne echinoderms.*

I. Complete calyx with arms and stalk attached.
II. Complete calyx with arms but no stalk attached.
III. Complete calyx with stalk but no arms attached.
IV. Complete calyx without arms or stalk.
V. Complete calyx, plates disarticulated in close proximity.
VI. Partial calyx, plates articulated.
VII. Partial calyx, plates disarticulated.
VIII. Disarticulated calyx plates.

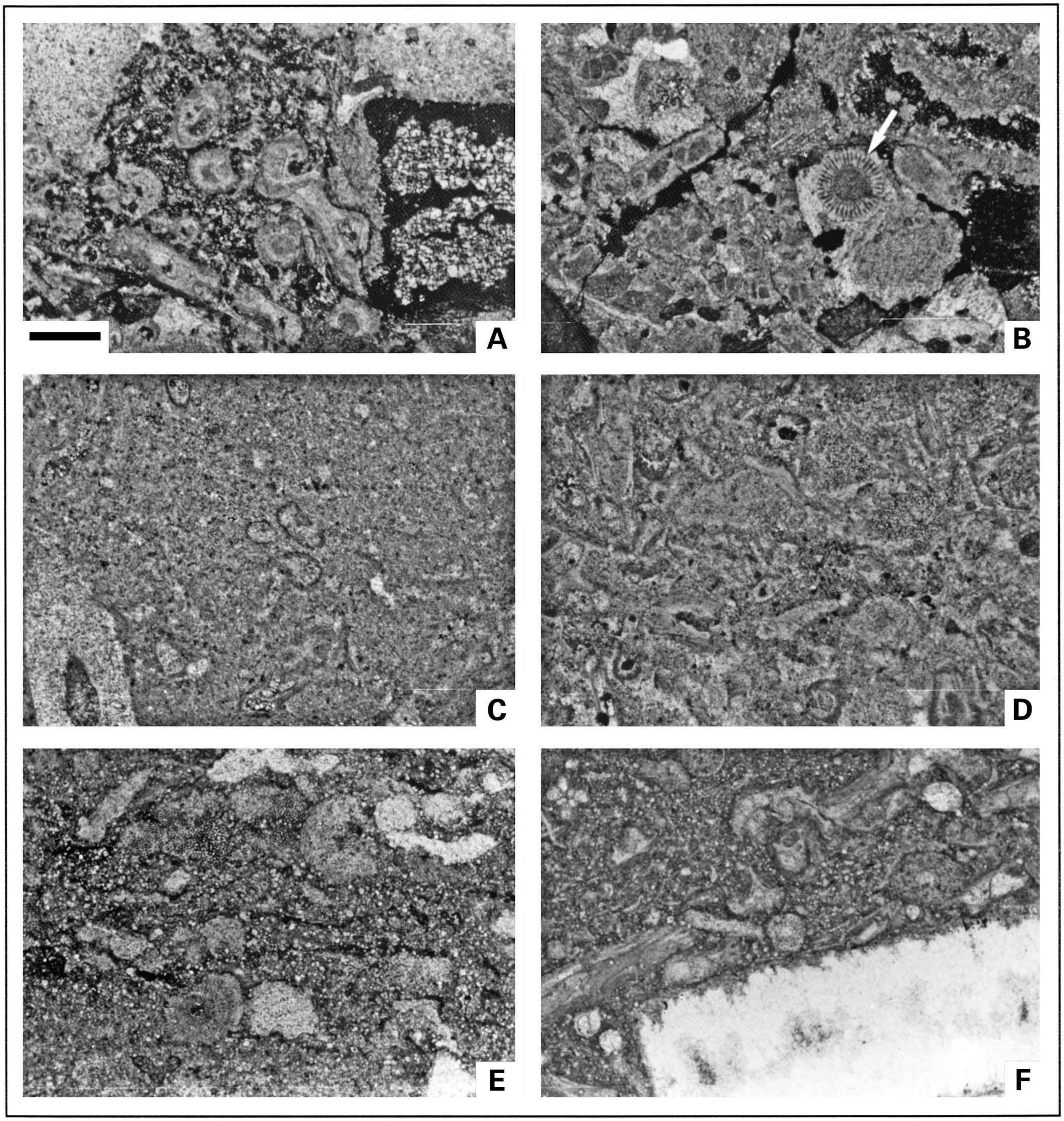

Figure 4. Photomicrographs of Fort Payne carbonates. Bar in fig. 4A=0.5 mm and is scale for all photos. A, B. Cave Springs crinoidal packstone buildup, crossed nicols. C. Pleasant Hill wackestone buildup, flank beds, plain light. D. Pleasant Hill wackestone buildup, basal bed of buildup, plain light. E. Wolf Creek South channelform packstone facies, base of graded bed shown in figure 17C, plain light. Lithic clast across lower part of photomicrograph. F. Wolf Creek/Caney Creek, sheetlike packstone facies, plain light. From Ausich and Meyer (1990); used by permission of the Geological Society of America.

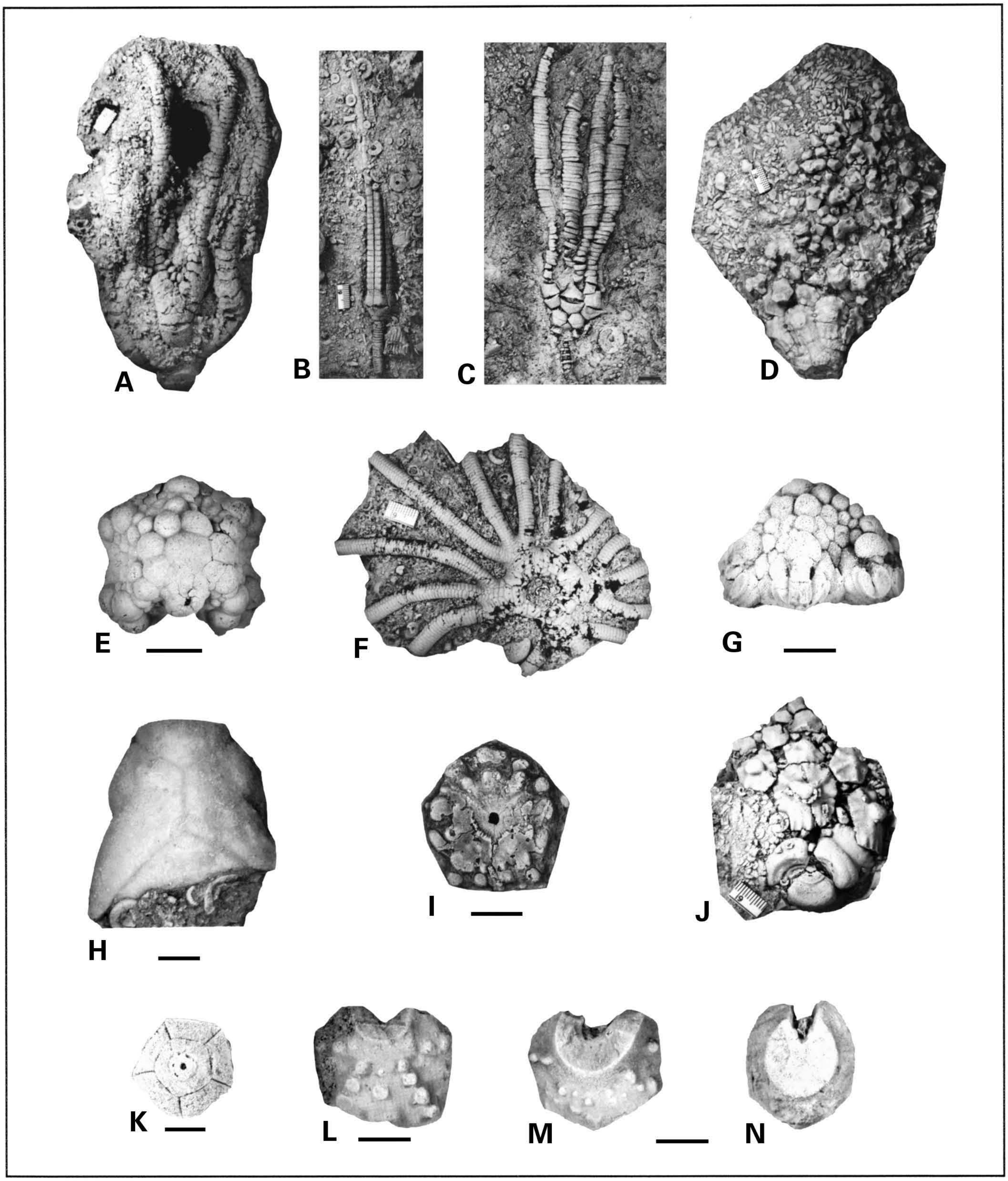

Figure 5. Representative examples of preservational categories listed in table 2. A, B, C, category I; D, category V; E, G, category IV; F, category II; H, I, K, category VI; J, category VII; L, M, N, category VIII. A, *Onychocrinus* sp., Indian Creek, Lake Cumberland, USNM 443600; B, *Synbathocrinus* sp., Indian Creek, USNM 443601; C, *Scytalocrinus* sp., Gross Creek, USNM 443602; D, *Actinocrinites* sp., Dale Hollow Reservoir, USNM 443603; E, G, *Agaricocrinus* sp., Wolf Creek, USNM 443604, 443605; F, *Agaricocrinus* sp., Seventy-six Falls, USNM 443606; H, *Halysiocrinus* sp., Rte. 1730, below Wolf Creek Dam, Lake Cumberland, USNM 443607; I, *Platycrinites hemisphaericus* (Meek and Worthen), Cumberland County, Kentucky, USNM 443608; J, *Actinocrinites* sp., Gross Creek, USNM 443609; K, *Synbathocrinus* sp., Gross Creek, USNM 443610; L, *Platycrinites hemisphaericus*, Cumberland County, Kentucky, USNM 443611; M, N, *Cyathocrinites* sp., Cumberland County, Kentucky, USNM 443612, 443613. Scale bars=1cm. USNM=U.S. National Museum specimen number. From Meyer, Ausich, and Terry (1989); used by permission of the Society for Sedimentary Geology (SEPM).

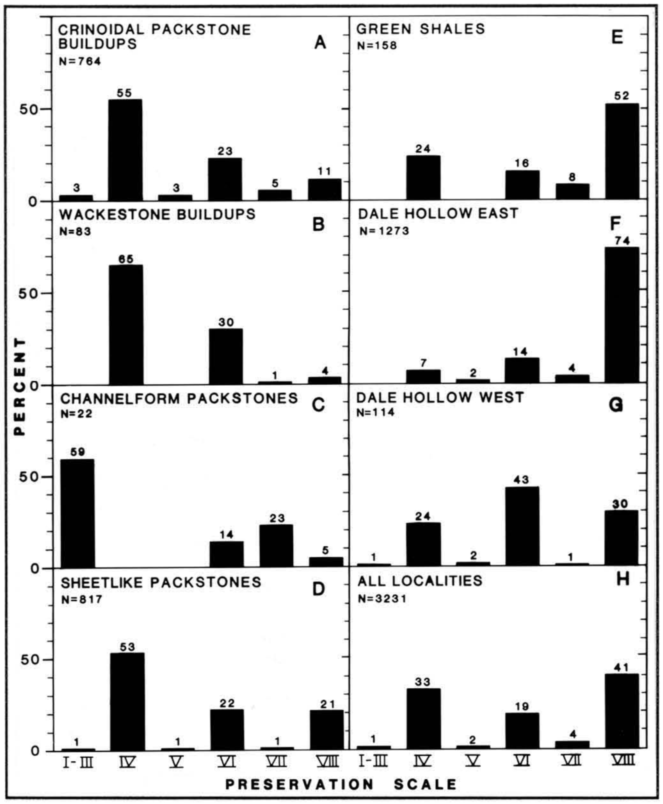

Figure 6. Pelmatozoan preservational profiles of the major Fort Payne facies. Categories I-VIII as in table 2. From Meyer, Ausich, and Terry (1989); used by permission of the Society for Sedimentary Geology (SEPM).

ECHINODERM PALEOECOLOGY, TAPHONOMY, AND SEDIMENTOLOGY OF THE FORT PAYNE FORMATION, DALE HOLLOW RESERVOIR, TENNESSEE

by

Richard E. Terry

Echinoderm-rich carbonates of the Fort Payne Formation were examined at seven localities in the southeastern corner of Dale Hollow Reservoir, Tennessee (fig. 1; Terry, 1990). These localities were examined because (1) they contained abundant pelmatozoans, (2) the carbonates are all sheetlike deposits, and (3) the localities lie on a ESE-WNW transect, providing a cross-sectional look at the infilling of the Fort Payne basin.

Twenty-two genera of crinoids and blastoids represented by 1,387 specimens were collected and statistically examined with cluster analysis and polar ordination analysis. Two echinoderm faunas were delineated: the Dale Hollow East (DHE) fauna, composed of 20 genera from the five easternmost localities, and the Dale Hollow West (DHW) fauna, composed of 13 genera from the two westernmost localities. The DHE fauna is dominated by pinnulated, large-plated, nonbatocrinid, monobathrid camerates and unpinnulated, cyathocrine inadunates and has not been previously reported from the late Osagean of North America. The DHW fauna is dominated by pinnulated, small-plated, boxlike, batocrinid, monobathrid crinoids. When compared to the Lake Cumberland faunas, the DHW fauna is most similar to the Lake Cumberland sheetlike fauna; the DHE fauna is not similar to any of the Lake Cumberland area echinoderm faunas.

The Fort Payne Formation on Dale Hollow Reservoir contains the following facies: green shale, dolomitic geode-rich siltstones, black shale, black shale with phosphatic nodules, black micritic carbonates, stacked carbonate turbidites, carbonate sheetlike debris flows, carbonate channel fills, and mounded green shale facies. Only the debris-flow facies was studied in detail because of its abundant echinoderm fauna. At the DHE localities, the debris-flow carbonates are thin- to medium-bedded, slightly wavy, discontinuous, crinoidal-bryozoan wackestones with minor packstones. These beds dip 1-4°. They are gray/black to white/gray in color, petroleum stained, 5-14 cm thick, ungraded and poorly sorted, and contain green shale (westernmost locality only) and black shale rip-up clasts (four easternmost localities only). The top of each bed contains a coarse-grained echinoderm lag deposit of calyxes, loose plates, and stem segments. Basal shearing and gouging have occurred in the underlying shale, and at the upper contact of each bed the large echinoderm grains project irregularly into the overlying shale. These DHE debris flows are interbedded with black shales except at the westernmost locality, where they are interbedded with green shales. The DHW debris flows differ in the following ways from the DHE debris flows: they are 5-23 cm thick, contain only green-shale rip-up clasts, dip 9-14°, are interbedded only with green shales, and are crinoidal packstones.

The taphonomy of the Fort Payne echinoderms at Dale Hollow Reservoir was examined using the eight-category classification scheme of Meyer and others (1989) (table 2; fig. 6F, G). The following trends were noted:

1. The Dale Hollow East faunas showed the highest degree of disarticulation (fig. 6F) and were dominated by loose isolated plates (74 percent).

2. The Dale Hollow West fauna is composed of whole and partial calyxes (24 percent and 43 percent, respectively, fig. 6G) and thus has a higher degree of articulation than the DHE fauna.

Taphonomic analysis of the combined Dale Hollow and Lake Cumberland data (fig. 6A-H) substantiates the progradational nature of the Fort Payne Formation in this region. The DHE assemblage has the highest degree of disarticulation and represents the most distal debris flows, as it is the farthest from the Borden Front (fig. 7, DHE). These flows were derived from an aerobic environment and deposited early in the Fort Payne basin in a dysaerobic to anaerobic basinal environment represented by the interbedded black shales and siltstones. The Lake Cumberland sheetlike deposits have the highest degree of articulation. On the basis of their stratigraphic and geographic position, these deposits are interpreted to have been deposited in relatively deep water conditions on the lower part of the Fort Payne slope (abandoned Borden delta slope) (fig. 7, LC). The Dale Hollow West sheetlike facies is intermediate with respect to the Dale Hollow East and Lake Cumberland assemblages in preservational style (fig. 6D, F, G). These debris flows are interpreted to have been deposited at shallower depths than the other two assemblages and on a steeper part of the Fort Payne paleoslope (fig. 7, DHW; based partly on relative dips).

DESCRIPTION OF LOCALITIES FOR DAY 1

Localities for Day 1 are shown on figure 8. All localities will be reached by boat on Lake Cumberland.

PLEASANT HILL

This locality (PH, fig. 8) is just north of Pleasant Hill Dock, on the western side of the mouth of Caney Creek, Lake Cumberland. Jamestown 7.5-minute quadrangle, Russell County, Kentucky (Carter Coordinate System grid location given for all localities as follows: 1600 FEL, 1800 FSL, sec. 11, F-54 = 1600 ft from east line, 1800 ft from south line,

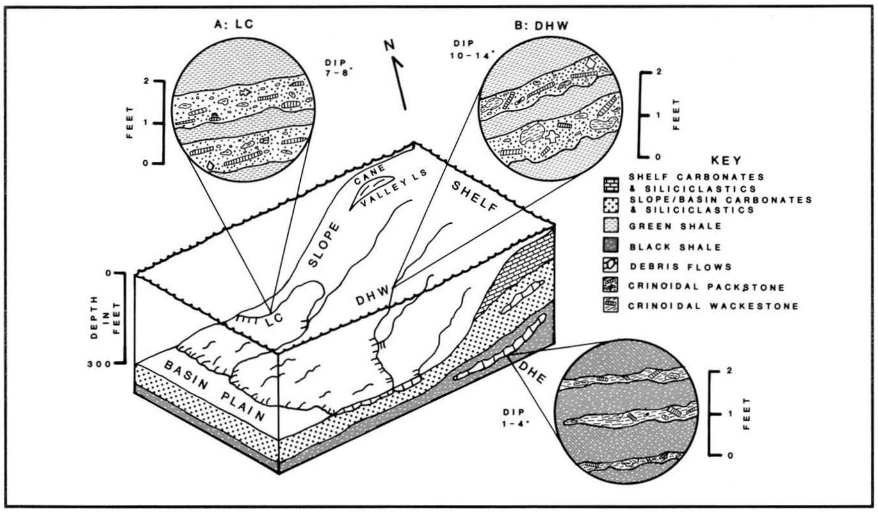

Figure 7. Block diagram depicting a model of clinoform deposition for the Fort Payne Formation in the Cumberland Saddle region (modified from Terry, 1990). In this model, sheetlike carbonate facies represent line-source sedimentation rather than point-source sedimentation (Klein, 1974; Hannan, 1975; Pryor and others, 1974). LC, Lake Cumberland sheetlike facies; note thick, continuous nature of carbonate beds and interbedding with green shale. DHW, sheetlike facies; note steeper depositional dips compared to Lake Cumberland facies. DHE, sheetlike facies; note thin, discontinuous nature of carbonate beds and interbedding with black shale. Not to scale horizontally.

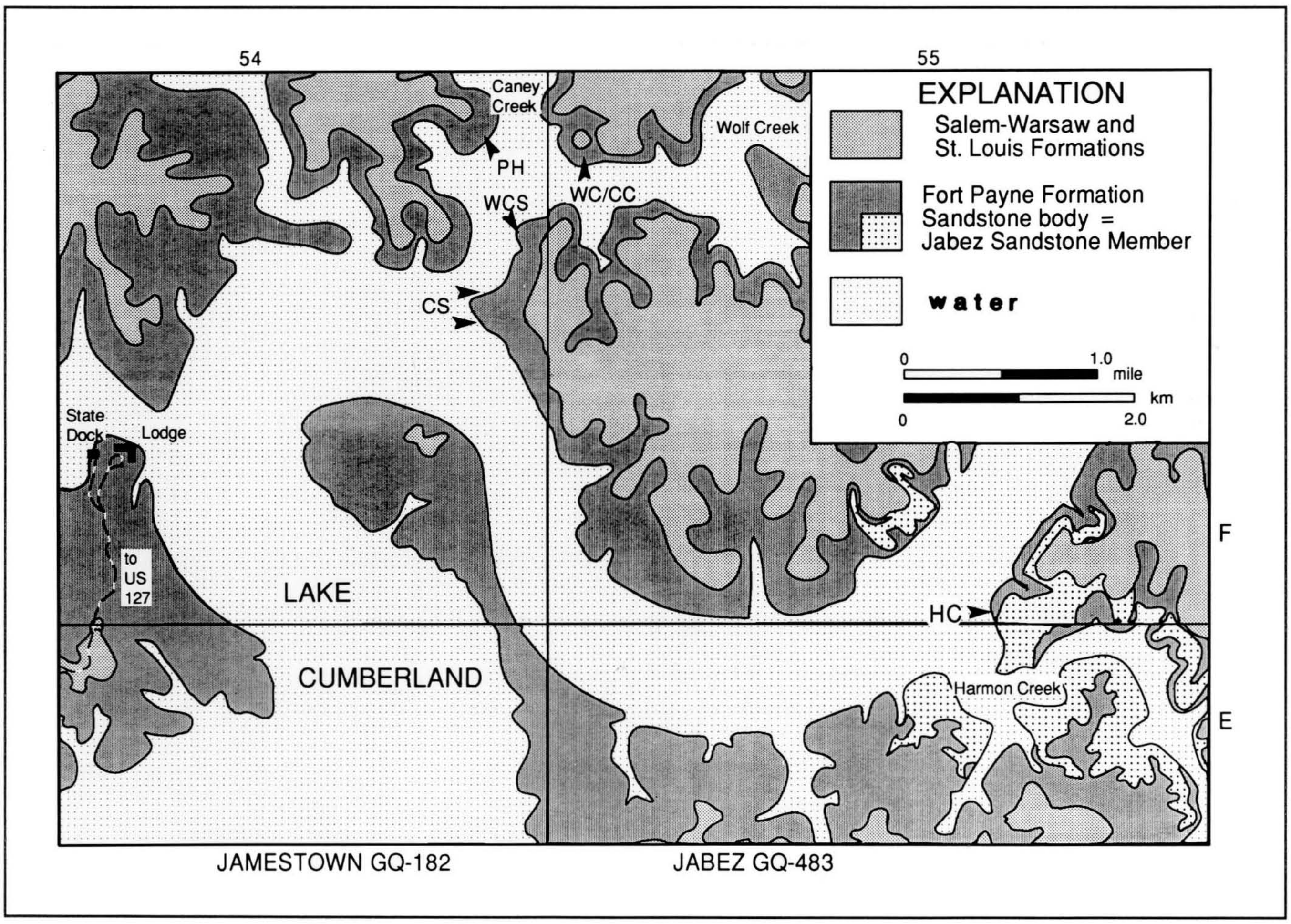

Figure 8. Detailed map of localities for Day 1 (area A of fig. 1), Jamestown and Jabez 7.5-minute quadrangles, Kentucky. CS, Cave Springs; HC, Harmon Creek; PH, Pleasant Hill; WC/CC, Wolf Creek/Caney Creek; WCS, Wolf Creek South. GQ numbers are the numbers of the U.S. Geological Survey Geologic Quadrangle Series maps. Divisions E, F, 54, and 55 are Carter Coordinate grids. Modifed from Lewis and Potter (1978).

section 11, grid F-54). It can be reached by land from Route 1680 from Jamestown.

The Pleasant Hill buildup is a single, small, typical mud mound with both flanks exposed (fig. 9). At low lake level, the green-shale mound underlying the wackestone mound can be seen. Green shale is well exposed above and lateral to the carbonate buildup to both the north and south. A measured section on the southern flank of the buildup contains several features common to Fort Payne wackestone buildups (fig. 10). There is a basal crinoidal packstone about 30 cm thick, followed by massive crinoidal wackestones (fig. 10, unit 1). The wackestones thicken down-dip from the crest over the green-shale mound. The upper surface of the wackestone units has a mottled appearance in which gray wackestone is broken up by a brown-weathering texture (fig. 9C). This mottling commonly has a brecciated appearance. A thin green-shale break (fig. 10, unit 4) occurs above the wackestones and is succeeded by a thin crinoidal packstone (fig, 10, unit 5). In place crinoid holdfasts have been found in this upper unit and also on bedding surfaces lower in the mound. The green shale above the mound contains thin crinoidal packstones.

Fossils collected from this locality are listed in table 3. The crinoid fauna is dominated by monobathrid camerates (fig. 11, wackestone buildups). Crinoids are typically preserved as whole or partial calyxes without arms or stalk attached, and in place holdfasts are present.

We interpret the Pleasant Hill buildup, as well as other wackestone mounds in the Fort Payne such as the Harmon Creek and Owens Branch buildups, as autochthonous mounds of carbonate mud accumulated with positive topographic relief over pre-existing mounds of siliciclastic mud. The underlying green-shale mound was initiated through sediment baffling and trapping by benthic organisms, but clastic deposition was superseded by carbonate deposition as a result of either increased carbonate production or reduced clastic influx. The siliciclastic composition of "background" Fort Payne sediments (the facies enclosing carbonate buildups) requires an autochthonous origin for the carbonate muds. On the basis of similarity of petrographic constituents, including the presence of dasycladacean algae, we regard these Fort Payne wackestone mounds to represent the shallow-water (photic zone), phase D of the Waulsortian facies model recently proposed by Lees and Miller (1985) and Lees and others (1985).

HARMON CREEK

This locality locality (HC, fig. 8) is on the eastern side of the mouth of Harmon Creek, Lake Cumberland. It is probably related to a small exposure on the western side of the mouth of Harmon Creek. Jabez 7.5-minute quadrangle, Wayne County, Kentucky (2300 FEL, 400 FSL, sec. 23, F-55).

This locality provides excellent exposure of both flanks of a wackestone mound as well as the green shales below, above, and flanking the buildup, and crinoidal packstones within the overlying green shales (fig. 12). The crest of this buildup is eroded away, but was positioned toward the west in the present location of the main body of the lake. The shoreline exposure is approximately parallel to depositional strike (N29°E, dip, 11° east) along the eastern flank of the buildup. Geopetal fabrics measured within the lumina of crinoid columnals on joint surfaces perpendicular to depositional dip indicate a 10° rotation of the flank toward the buildup center. Therefore, present geometry represents a minimum relief of the wackestone buildup.

The fauna from Harmon Creek is listed in table 4. Harmon Creek is the type section for the Jabez Sandstone Member of the Fort Payne Formation (Kepferle and others, 1980). The Jabez is exposed well above lake level along the northern and southern shores of Harmon Creek.

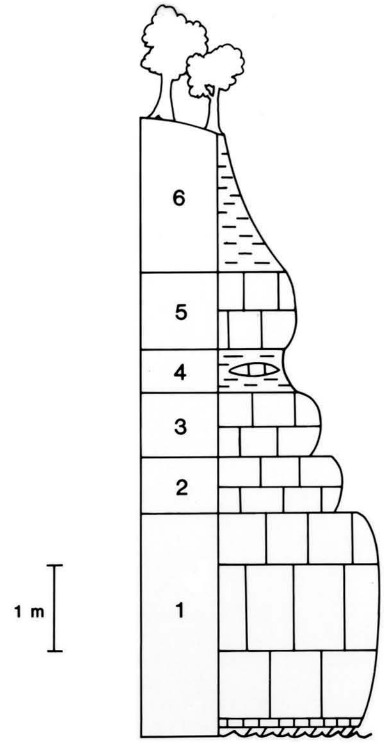

Figure 10. Stratigraphic section on south flank of Pleasant Hill buildup (see fig. 9A). Base at lake level, 701 ft. Unit 1, massive wackestone containing irregular chert masses, basal 10 cm coarse crinoidal limestone; unit 2, massive crinoidal packstone/grainstone containing abundant irregular chert masses; unit 3, massive crinoidal grainstone containing less silicified material than units below, and coarse crinoidal debris in pockets; unit 4, fossiliferous green shale and crinoidal packstone; unit 5, massive crinoidal grainstone/packstone containing chert masses and geodes; unit 6, unfossiliferous green shale.

TABLE 3 — *Faunal list from the wackestone buildup at Pleasant Hill.*

CRINOIDS

DIPLOBATHRID CAMERATES
Gilbertsocrinus tuberosus

MONOBATHRID CAMERATES
Abatocrinus grandis
Actinocrinites sp. "nonlobate"
Actinocrinites sp. "lobate"
Agaricocrinus spp.
Alloprosallocrinus conicus
Eretmocrinus magnificus
Eretmocrinus ramulosus
Eucladocrinus millebrachiatus
Macrocrinus sp.
Platycrinites hemisphaericus

DISPARIDS
Catillocrinus tennesseeae
Halysiocrinus spp.
Synbathocrinus swallovi

PRIMITIVE CLADIDS
Barycrinus sculptilis
Barycrinus stellatus
Cyathocrinites spp.

ADVANCED CLADIDS
Adinocrinus sp.
?*Parisocrinus* sp.
adv. cladid primitive grade C

FLEXIBLES
Metichthyocrinus clarkensis

BLASTOIDS

Xyeleblastus magnificus

OTHER FAUNAL ELEMENTS

FORAMINIFERA
Ammodiscus? sp.
Tolypammina sp.

SPONGES
siliceous sponge spicules

COELENTERATA
Cladochonus beecheri

RHYNCONELIID BRACHIOPODS
misc. juvenile brachiopods

GASTROPODS
Platyceras (Platyceras) equilateralis

BIVALVES
unknown bivalves

TRILOBITA
Australosutra sp.
Proetus (Pudoproetus) sp.

VERTEBRATA
palaeoniscoid fish teeth

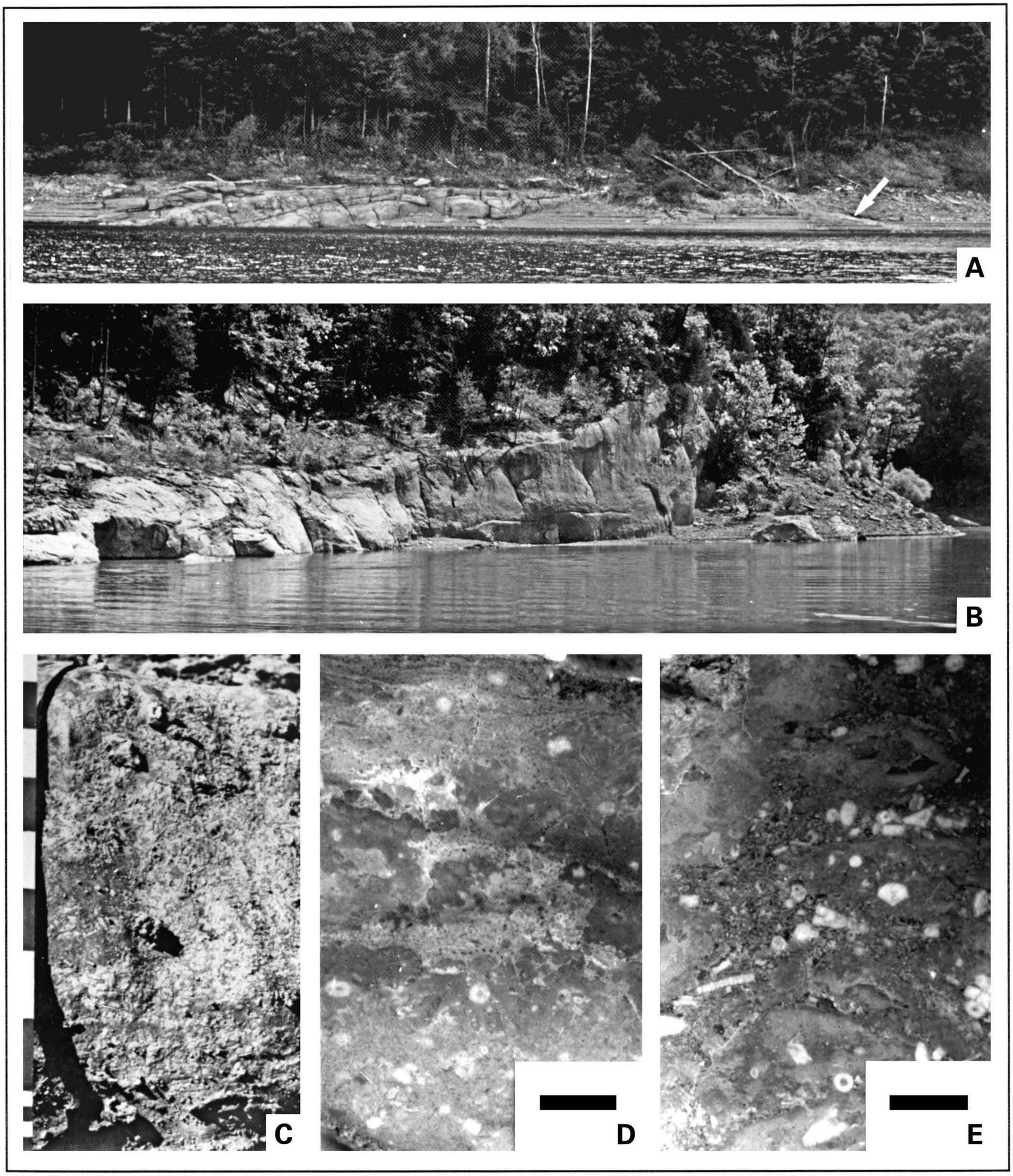

Figure 9. Wackestone-buildup facies. A. Cross section through Pleasant Hill buildup. Note dipping flank beds on both sides; arrow denotes northern flank; thickness of carbonates on left flank is 4 m. B. Western flank of Owens Branch buildup; maximum thickness of wackestone here is 14 m. C. Northern flank of Pleasant Hill buildup, wackestone on flanks (vertical surface). Note mottled appearance, silicified masses; scale divisions=10 cm. D, E. Polished sections of wackestone-buildup lithologies, Pleasant Hill; scale bar=1 cm. From Ausich and Meyer (1990); used by permission of the Geological Society of America.

CAVE SPRINGS

This locality (CS, fig. 8) is on the shores of Cave Springs Ridge southeast of the mouth of Wolf Creek along the main body of Lake Cumberland (2000 WEL, 2800 NSL, sec. 20, F-54), and along the southeastern shore of Wolf Creek where it joins the main body (2500 WEL, 2700 SNL, sec. 20, F-54), Jamestown 7.5-minute quadrangle, Russell County, Kentucky.

Cave Springs is a crinoidal packstone buildup (fig. 13) exposed along two stretches of shoreline trending roughly east-west (Cave Springs North) and northwest-southeast (Cave Springs South). Dip reversal of the carbonates occurs along both sections. A stratigraphic section was measured along the northwestern flank at Cave Springs South (fig. 14). The massive crinoidal packstones thicken downdip as in the wackestone mounds. Unlike the wackestone mounds,

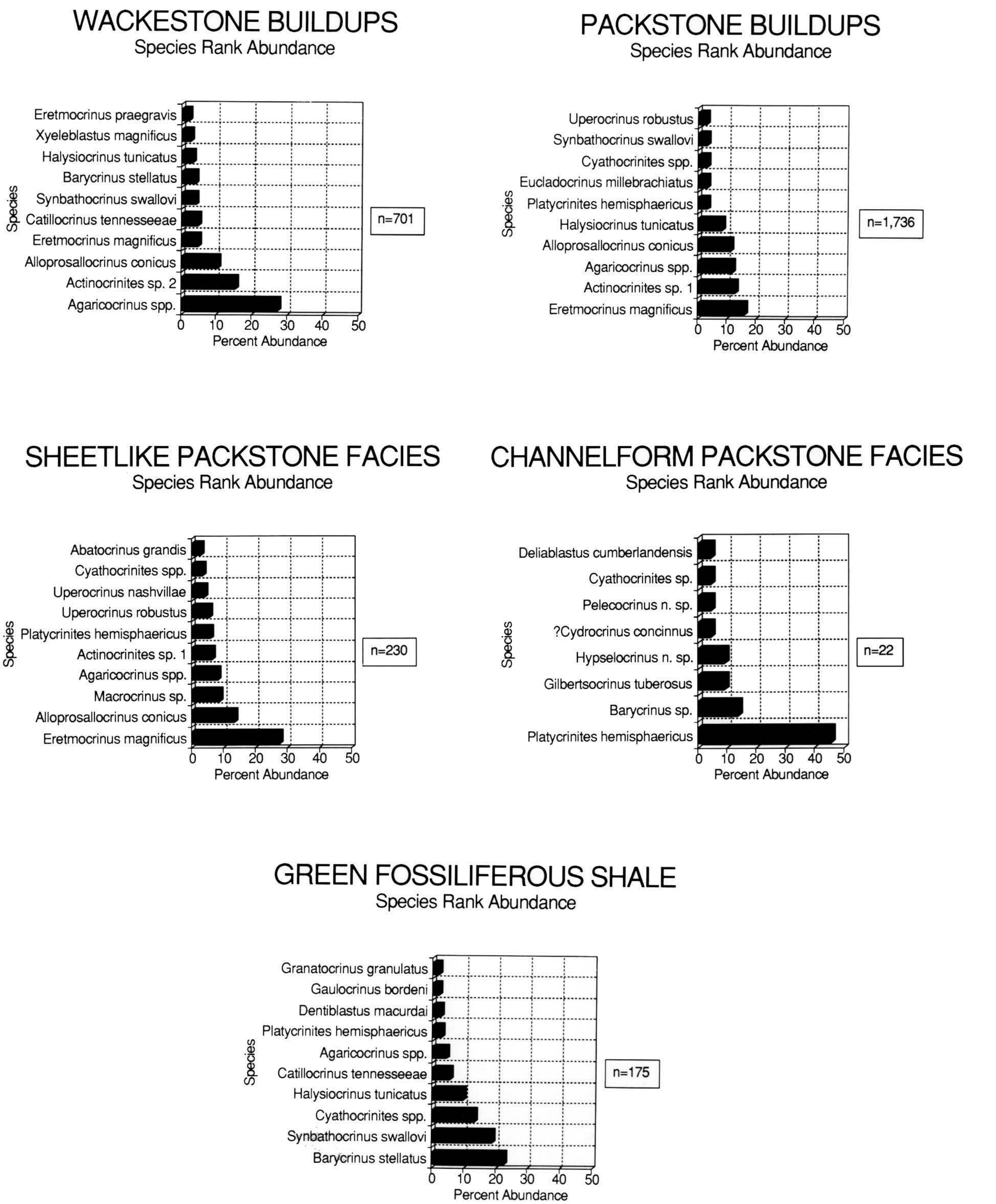

Figure 11. Histograms showing relative abundance of the most abundant pelmatozoan echinoderm species for each carbonate facies of the Fort Payne Formation, Lake Cumberland, Kentucky.

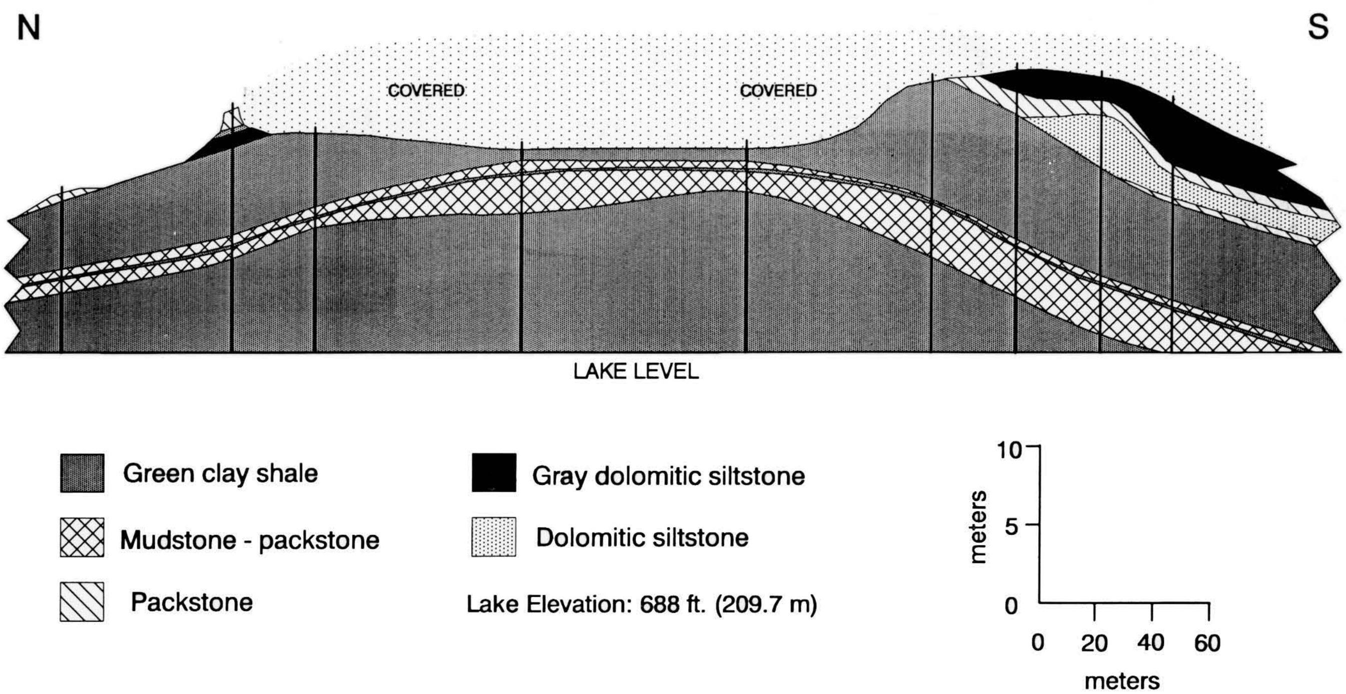

Figure 12. Cross section of Harmon Creek buildup. By W. A. Norris.

TABLE 4 — *Faunal list from the wackestone buildup facies at Harmon Creek. This list includes taxa from the carbonates as well as from the green shale situated beneath the carbonate buildup.*

CRINOIDS

DIPLOBATHRID CAMERATES
Gilbertsocrinus tuberosus

MONOBATHRID CAMERATES
Abatocrinus? sp.
Actinocrinites sp. "nonlobate"
Actinocrinites sp. "lobate"
Agaricocrinus spp.
Alloprosallocrinus conicus
Eretmocrinus magnificus
Eretmocrinus praegravis
Eucladocrinus millebrachiatus
Macrocrinus sp.
Paradichocrinus planus
Platycrinites hemisphaericus
Uperocrinus nashvillae

DISPARIDS
Catillocrinus tennesseeae
Halysiocrinus tunicatus
Synbathocrinus swallovi

PRIMITIVE CLADIDS
Barycrinus sculptilis
Cyathocrinites spp.

ADVANCED CLADIDS
?*Hypselocrinus* sp.
?*Parisocrinus* sp.
Springericrinus magniventrus

FLEXIBLES
Mespilocrinus romingeri

BLASTOIDS

Dentiblastus macurdai
Granatocrinus granulatus
Hadroblastus breimeri
Xyeleblastus magnificus

OTHER FAUNAL ELEMENTS

SPONGES
siliceous sponge spicules

COELENTERATA
Amplexizaphrentis sp.
Amplexus sp.
Cladochonus beecheri
Cladochonus crassus
Cyathaxonia cyndon
Striatopora sp.
Trochophyllum verneuilanum

CYSTOPORATE BRYOZOA
Cystodictya spp.
Meekopora? sp.

FENESTRATE BRYOZOA
Acanthocladia? sp.
Alternifenestella sp.
Fenestella spp. [sensu lato]
Kingopora sp.
Minilya sp.
Penniretepora sp.
Ptylopora sp.
Rectifenestella sp. A
Rectifenestella sp. B
Spinofenestella sp.
Thamniscus divaricans

CRYPTOSTOME BRYOZOA
Acanthoclema sp.
Nicklesopora? sp.
Saffordotaxis incrassata

INARTICULATE BRACHIOPODS
Orbiculoidea sp.

ORTHID BRACHIOPODS
Rhipidomella oweni

STROPHOMENID BRACHIOPODS
Marginatia cf. *M. fernglenensis*
Ovatia sp.
Quadratia waynensis
Rhytiophora sp.
Rugosochonetes shumardianus
Schuchertella sp.

SPIRIFERID BRACHIOPODS
Hustedia sp.
Plectospirifer? sp.
Punctospirifer? *subelliptica*
unknown spirifer

ATRYPID BRACHIOPODS
Cleiothyridina parvirostra
Nucleospira sp.
Torynifer sp.

RHYNCONELLID BRACHIOPODS
Rhynchopora beecheri

TEREBRATULID BRACHIOPODS
Dielasma crawfordsvillensis

???BRACHIOPOD
Voiseyella sp.

GASTROPODS
Lunulazona springeri
Mourlonia cf. *M. textiligera*
Platyceras (Orthonychia) acutirostre
Platyceras (Platyceras) equilateralis

BIVALVES
"Avicula" recta
Cypricardinia scitula
Streblochondria cancellatus
Streblopteria? *fragilis*
nuculoid sp.

TRILOBITA
Australosutra sp.
Proetus (Pudoproetus) sp.

OSTRACODES
misc. ostracodes

ECHINOIDS
misc. echinoids

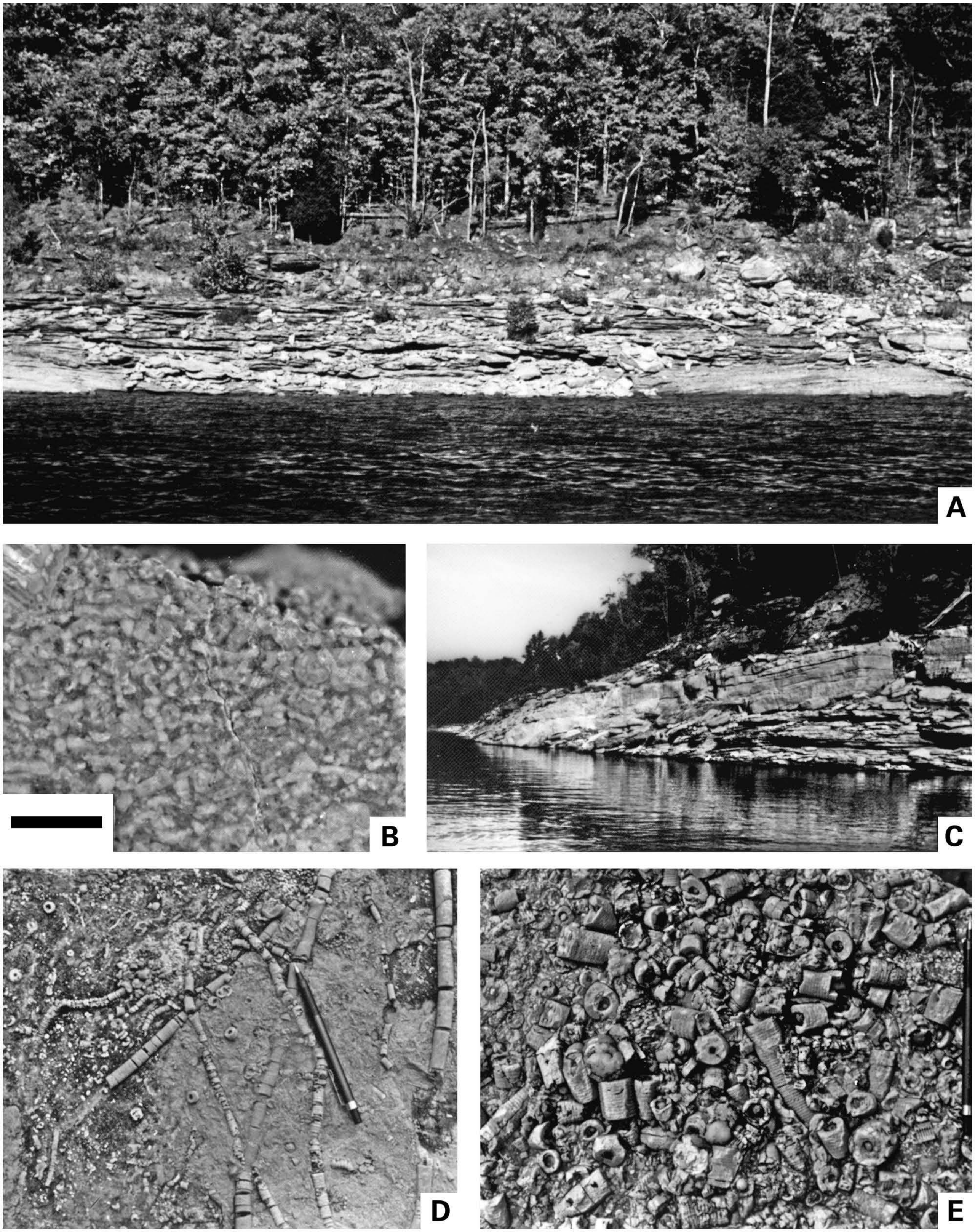

Figure 13. Cave Springs crinoidal-packstone buildup. A. Central portion of buildup with interbedded packstones and fossiliferous green shales; tree line about 15 m above water level. B. Polished section of flank lithology; scale bar=1 cm. C. Western flank of buildup; dominant carbonate bed 4 m thick. D. Bedding surface on buildup flank exposing crinoid columns; length of pencil=13 cm. E. Bedding surface on buildup flank with very coarse crinoidal debris; length of pencil=13 cm. From Ausich and Meyer (1990); used by permission of the Geological Society of America.

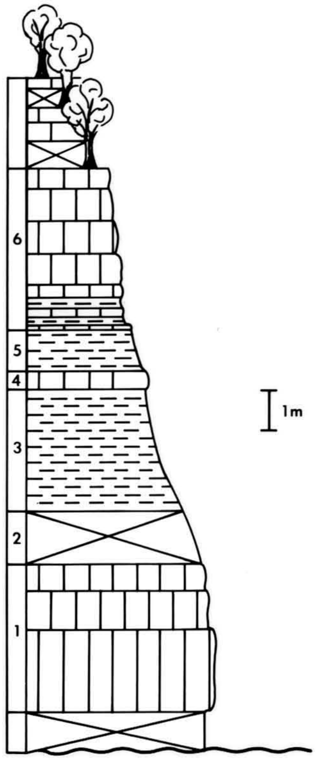

Figure 14. Stratigraphic section of Cave Springs South buildup. Base at lake level (701 ft) to base of unit 1, covered. Unit 1, crinoidal grainstones in beds that thicken downdip; unit 2, covered; unit 3, fossiliferous green shale with packstone lenses; unit 4, crinoidal packstone; unit 5, green shale with crinoidal packstone lenses; unit 6, thin packstones interbedded with green shale, overlain by thicker packstones.

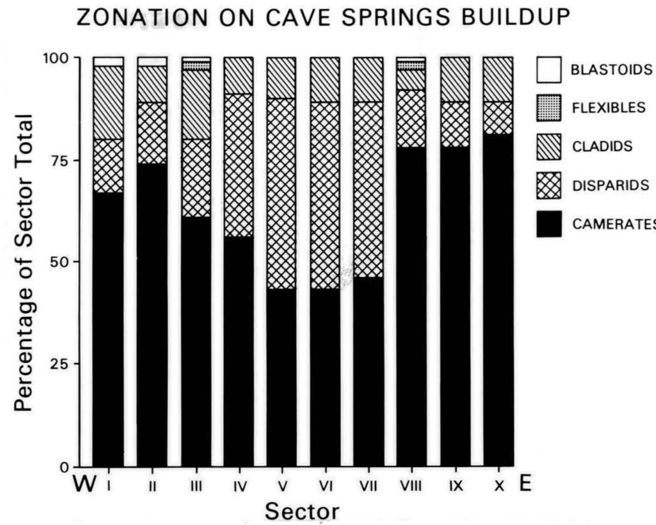

Figure 15. Zonation of echinoderms across Cave Springs South buildup. Each sector 25 m wide. Totals for each sector include specimens collected plus specimens censused on outcrop but not collected. Flexibles, cladids, disparids, and camerates are crinoid subclasses.

the crest of the crinoidal-packstone buildup contains interbedded packstones and green shale (fig. 13A).

Table 5 gives the fauna of the Cave Springs buildup, and the relative abundance of pelmatozoans is shown in figure 11 (packstones buildups). A transect across the Cave Springs South exposure was collected over 25-m intervals, and all pelmatozoans were tabulated for each sector throughout the exposed stratigraphy. The results of this census (fig. 15) show a zonation across the buildup in which the flanks are dominated by monobathrid camerates, whereas the crest shows a greater proportion of disparid inadunates. The zonation may in part reflect the presence of interbedded green shales and packstones over the crest of the mound. This symmetrical differentiation of echinoderms is interpreted as a primary ecologic zonation across the buildup.

We interpret the Cave Springs buildup as an autochthonous crinoidal mound with topographic relief for the following reasons: (1) moundlike geometry, (2) gradational basal contact of the packstones with underlying green shales, (3) lack of sedimentary structures, (4) distinctive fauna that is symmetrically zoned, (5) echinoderm taphonomy, and (6) presence of in place crinoid holdfasts.

WOLF CREEK/CANEY CREEK

This locality (WC/CC, fig. 8) is on the northern shore of Wolf Creek where Wolf Creek joins Caney Creek at the southern end of Ono Ridge. Jabez 7.5-minute quadrangle, Russell County, Kentucky (600 EWL, 800 NSL, sec. 15, F-55).

This locality provides a typical example of sheetlike crinoidal limestones interbedded with "background" Fort Payne siliciclastic siltstones or mudstones (figs. 16, 17). No carbonate buildup is present. Instead, a series of graded carbonates occurs. The base of each graded bed is a poorly sorted, coarse-grained, commonly cross-bedded packstone that grades upward into a well-sorted, coarse, sand- to silt-sized packstone to grainstone. Graded carbonates are lenticular to tabular. Their basal contacts are sharp and irregular, and their upper contacts with the siliciclastics are planar and burrowed. Siltstone clasts are common in the basal part of the coarse crinoidal packstones. Variation in thickness of the basal packstone contributes to considerable lateral variation in carbonate thickness (fig. 18), and some beds pinch out abruptly.

The fauna from the Wolf Creek/Caney Creek locality is given in table 6. The echinoderm fauna is dominated by monobathrid camerate crinoids as in the carbonate-buildup facies, but different taxa are among the dominants (fig. 11, sheetlike packstones). Crinoid preservation covers the entire spectrum and there is a high degree of disarticulation. Whole or partial calyxes are common, but specimens with arms or stalk attached are rare. Holdfasts are present but are not in growth position.

We assign an allochthonous origin to the sheetlike packstone facies, as represented at Wolf Creek/Caney Creek and elsewhere, on the basis of the following features: (1) bed form, with planar tops and erosional basal contacts, (2) graded bedding, (3) distinctive pelmatozoan fauna, (4) pelmatozoan taphonomy, and (5) lack of in place holdfasts. Segments of large crinoid stalks and calyxes commonly protrude from the upper surface of the packstones, suggesting clasts rafted along in debris flows.

WOLF CREEK SOUTH

This locality (WCS, fig. 8) is on the southern shore of Wolf Creek where it joins Caney Creek, Cave Springs Ridge, Jamestown 7.5-minute quadrangle, Russell County, Kentucky (800 WEL, 500 SNL, sec. 20, F-54).

At this locality a channelform body of crinoidal packstone and grainstone cuts into the "background" siltstone facies (fig. 19). This carbonate facies is characterized by a series of stacked, generally thin-bedded, graded crinoidal packstones, interbedded with crinoidal packstones with low angle crossbedding. Bedding surfaces within this sequence strike, on average, N69°E and dip 5.5° to the northwest (fig. 20). The sequence is thickest at the center of the exposure and thins east and west. The base truncates the siltstone at a progressively higher stratigraphic position as distance from the center increases.

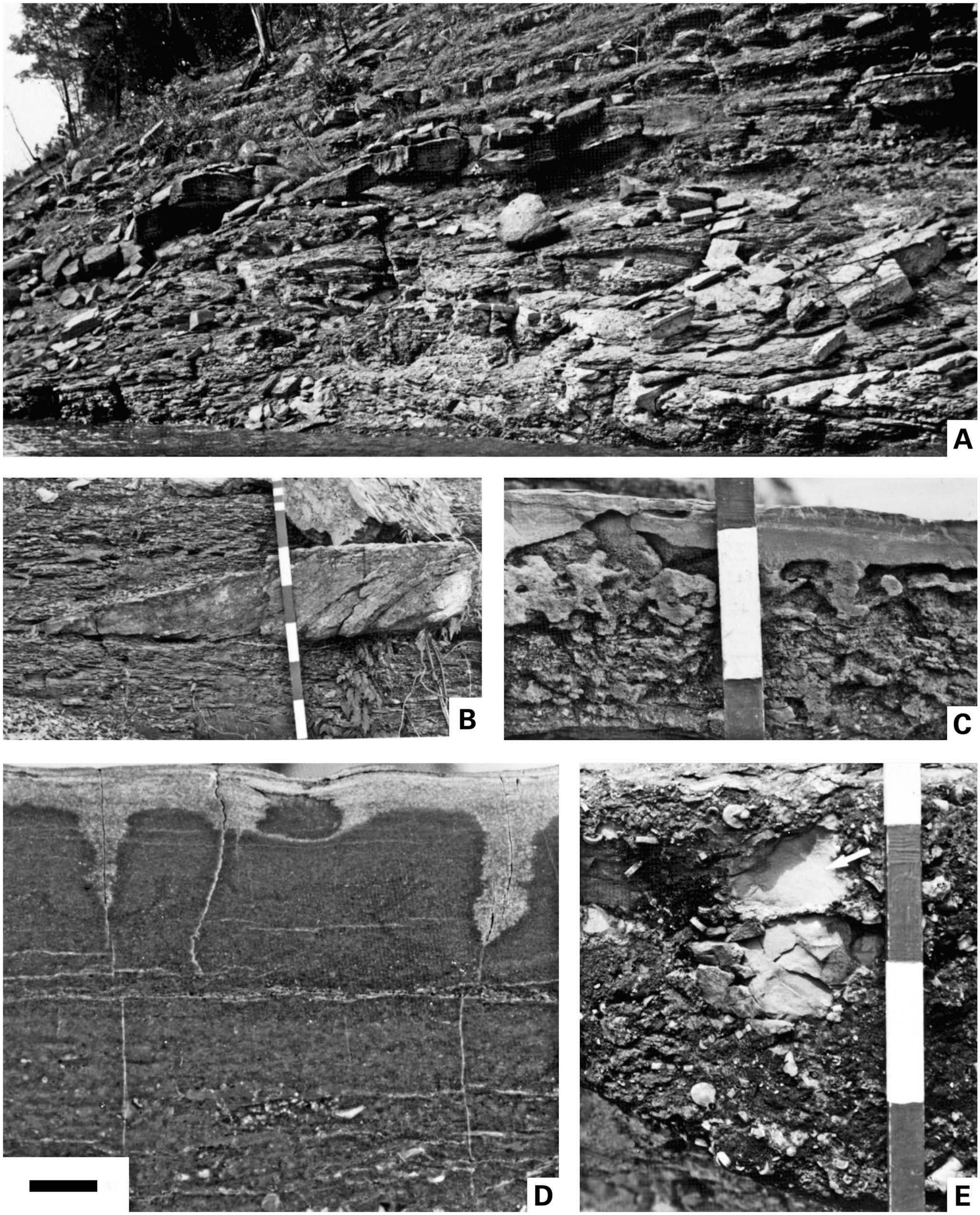

Figure 16. Sheetlike-packstone facies at Wolf Creek/Caney Creek outcrop. A. Interbedded carbonates and siltstones; tree line about 12 m above water level. B. Rapidly thinning packstone with high-angle crossbedding enclosed by siltstones; scale divisions=10 cm. C. Graded bed, coarse crinoidal packstone at base, fine-grained laminated carbonate at top; see fig. 16D; scale divisions=10 cm. D. Polished section of graded bed shown in 16C; scale bar=1 cm. E. Large lithic clast at base of packstone (arrow); scale divisions=10 cm. From Ausich and Meyer (1990); used by permission of the Geological Society of America.

TABLE 5 — *Faunal list from the crinoidal packstone-buildup facies at Cave Springs. This list includes the entire buildup (Cave Springs South and Cave Springs North localities).*

CRINOIDS

DIPLOBATHRID CAMERATES
Gilbertsocrinus tuberosus

MONOBATHRID CAMERATES
Abatocrinus grandis
Abatocrinus stereopes
Actinocrinites sp. "nonlobate"
Agaricocrinus spp.
Alloprosallocrinus conicus
Dorycrinus gouldi
Eretmocrinus magnificus
Eretmocrinus praegravis
Eretmocrinus ramulosus
Eucladocrinus millebrachiatus
Macrocrinus sp.
Paradichocrinus planus
Platycrinites hemisphaericus
Platycrinites spp.
Uperocrinus nashvillae
Uperocrinus robustus
unknown dichocrinid

DISPARIDS
Catillocrinus tennesseeae
Halysiocrinus tunicatus
Halysiocrinus sp.
Synbathocrinus swallovi
Synbathocrinus sp.

PRIMITIVE CLADIDS
Atelestocrinus sp.
Barycrinus sculptilis
Barycrinus spurius
Barycrinus stellatus
?*Cestocrinus* sp.
Cyathocrinites spp.

ADVANCED CLADIDS
Abrotocrinus sp. cf. *A. unicus*
Adinocrinus sp.
?*Holcocrinus* sp. 2
Pelecocrinus sp.
Scytalocrinus decadactylus
Springericrinus magniventrus
adv. cladid primitive grade B
adv. cladid primitive grade C
adv. cladid advanced grade C

FLEXIBLES
Forbesiocrinus wortheni
Gaulocrinus veryi
Mespilocrinus kentuckyensis
Mespilocrinus romingeri
Wachsmuthicrinus spinulosus

BLASTOIDS

Deliablastus cumberlandensis
Dentiblastus macurdai
Hadroblastus breimeri
Xyeleblastus magnificus

OTHER FAUNAL ELEMENTS

FORAMINIFERA
Tolypammina sp.

SPONGES
siliceous sponge spicules

COELENTERATA
Amplexizaphrentis sp.
Amplexus sp.
Cladochonus beecheri
Cladochonus crassus
Cyathaxonia arcuata
Cyathaxonia cyndon
Striatopora sp.
Trochophyllum verneuilanum

CYSTOPORATE BRYOZOA
Cliotrypa sp.
Cystodictya spp.

TREPOSTOME BRYOZOA
indeterminate stenoporid

FENESTRATE BRYOZOA
Fenestella spp. [sensu lato]
Penniretepora sp.
Polypora sp.
Thamniscus divaricans

CRYPTOSTOME BRYOZOA
Acanthoclema sp.
Rhombopora? sp.
Saffordotaxis incrassata
Steblotrypa sp.
unknown cryptostome

ORTHID BRACHIOPODS
Rhipidomella oweni
unknown orthid

STROPHOMENID BRACHIOPODS
Marginatia? sp.
Rugosochonetes planumbona
Schuchertella sp.
Setigerites? sp.
misc. productids

SPIRIFERID BRACHIOPODS
Hustedia? sp.
Imbrexia montgomeryensis
Punctospirifer? *subelliptica*
Pseudosyrinx sp.
Unispirifer? *floydensis*?

ATRYPID BRACHIOPODS
Cleiothyridina parvirostra

RHYNCONELLID BRACHIOPODS
Rhynchopora beecheri

GASTROPODS
Platyceras (Orthonychia) acutirostre
Platyceras (Platyceras) equilateralis

BIVALVES
Cypricardinia scitula

TRILOBITA
Australosutra sp.
Proetus (Pudoproetus) sp.

ECHINOIDS
misc. echinoids

CONODONTA
misc. conodonts

VERTEBRATA
palaeoniscoid fish teeth

INCERTAE SEDIS
Cornulitella sp.

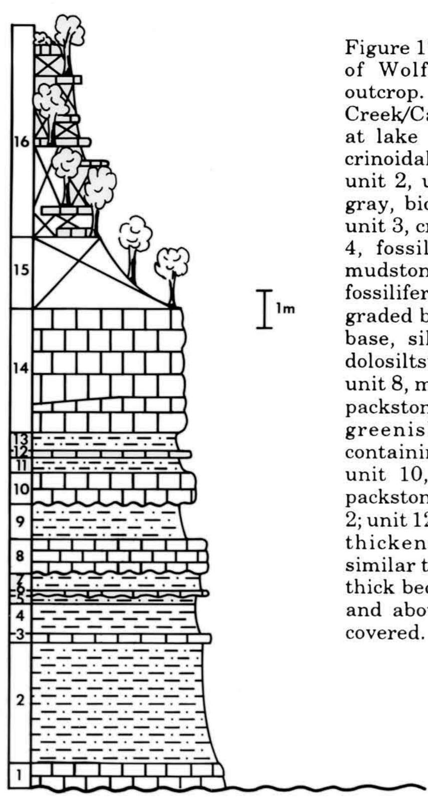

Figure 17. Stratigraphic section of Wolf Creek/Caney Creek outcrop. Location below Wolf Creek/Caney Creek sign. Base at lake level, 701 ft. Unit 1, crinoidal packstone/grainstone; unit 2, unfossiliferous greenish gray, bioturbated dolosiltstone; unit 3, crinoidal packstone; unit 4, fossiliferous grayish green mudstone to packstone; unit 5, fossiliferous dolosiltstone; unit 6, graded bed having packstone at base, siltstone at top; unit 7, dolosiltstone similar to unit 2; unit 8, massive, coarse crinoidal packstone; unit 9, unfossiliferous greenish gray dolosiltstone containing sandy channel-fills; unit 10, massive, fossiliferous packstone; unit 11, similar to unit 2; unit 12, graded packstone that thickens laterally; unit 13, similar to unit 2; unit 14, thin to thick bedded packstone; unit 15 and above, mostly wooded and covered.

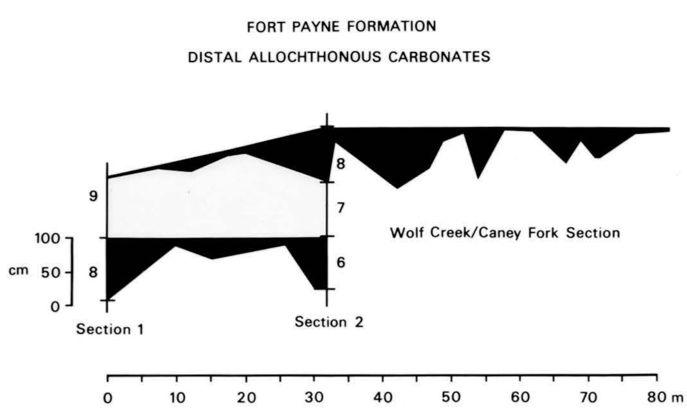

Figure 18. Variation in thickness of crinoidal packstones at Wolf Creek/Caney Creek outcrop. Section 1 shown in figure 17; section 2 located 32 m east of section 1. Crinoidal packstones shown in black; units 6, 7, 8 refer to section 2.

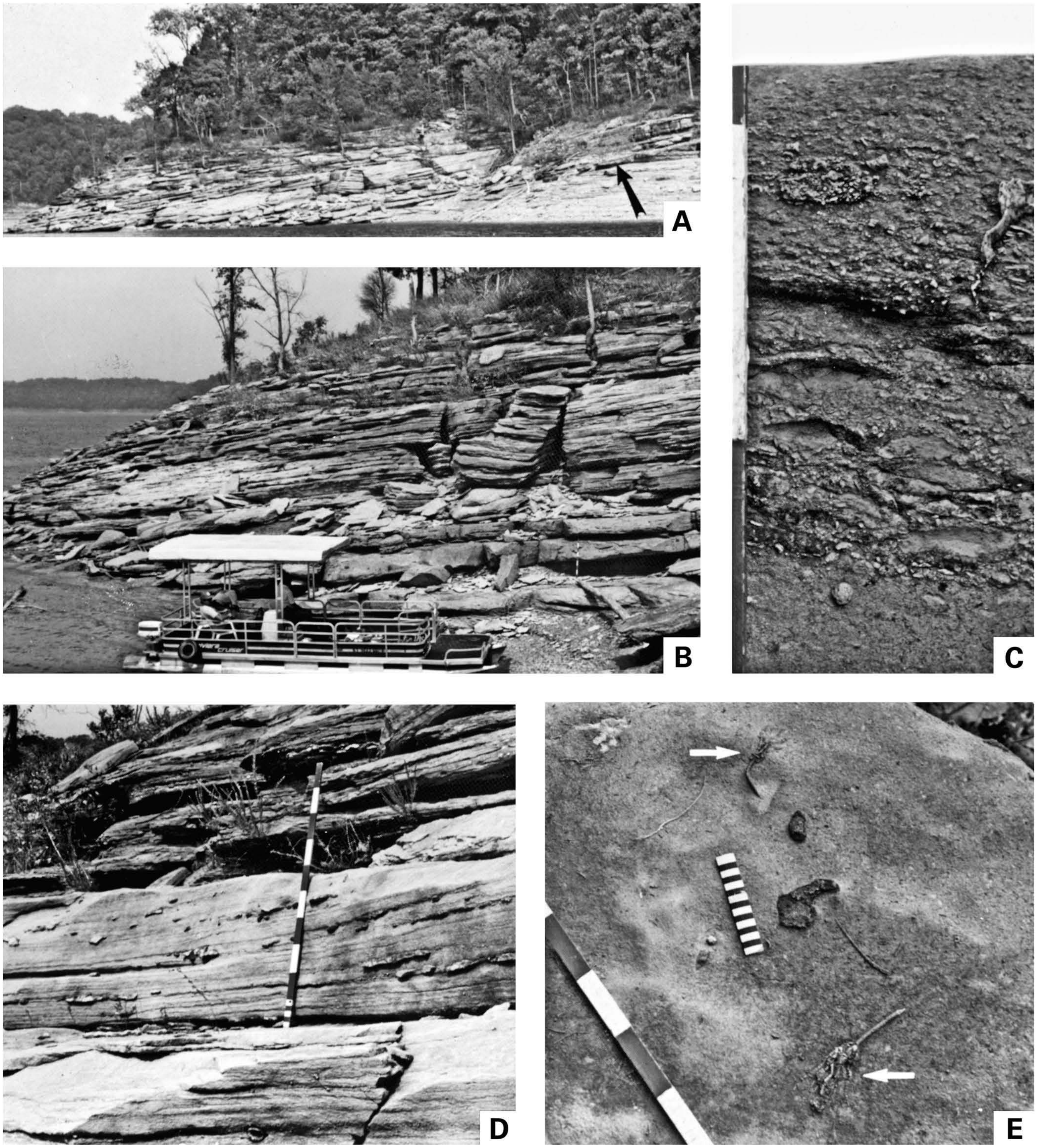

Figure 19. Channelform packstone facies at Wolf Creek South. A. Northwestward-dipping, thin-bedded crinoidal packstones showing truncation of horizontal siltstones (arrow); tree line about 15 m above water level. B. Thin-bedded packstones of channelform facies; meter stick for scale at lower right. C. Vertical section of graded bed with lithic clasts at base; scale divisions=10 cm. D. Low-angle crossbedding of carbonates within channel-fill sequence; meter stick for scale. E. Upper surface of bed shown in 19C with complete crinoids (arrows). Large scale divisions=10 cm. From Ausich and Meyer (1990); used by permission of the Geological Society of America.

Crinoids, particularly *Platycrinites hemisphaericus* and inadunates, dominate the fauna of this facies (table 7; fig. 11, channelform packstones) and present a remarkable taphonomic contrast. In view of the high degree of skeletal disarticulation throughout this series of graded and well-sorted beds, it is surprising that crinoids fully articulated with arms and stalk were found at this locality (fig. 19E). These specimens occur near the top of the sequence, at the top of a graded unit having coarse crinoidal debris and siltstone clasts at its base (fig. 19C). The packstone is capped by a thin silty shale. Some of the long crinoid stalks pass from the carbonate into the silt, demonstrating that the silt is the final depositional phase of what appears to be a carbonate turbidite. The crinoids were probably derived from upslope or from the margins of the channel and were engulfed in the turbidity flow or debris flow as it filled the channel. Beds lower in the sequence lack articulated specimens, probably because they were more distal to the living site than beds deposited during later stages of channel filling. The channelform facies is highly localized compared to the sheetlike allochthonous facies, but has also been recognized at a locality along the Indian Creek arm of Lake Cumberland.

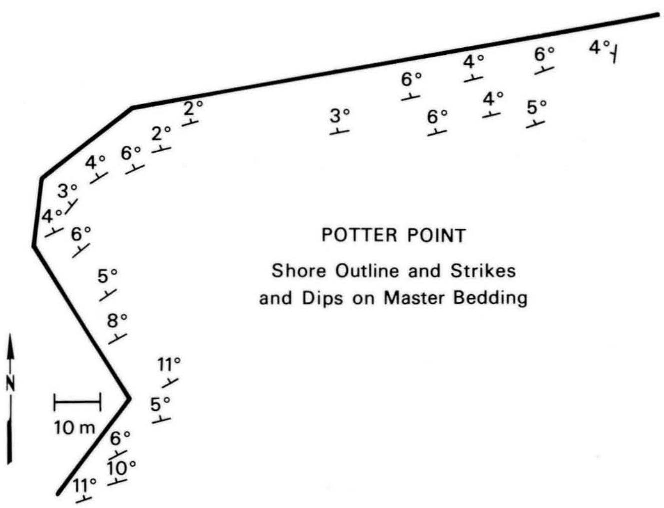

Figure 20. Outline map of shoreline at Wolf Creek South with strikes and dips of master bedding surfaces.

DESCRIPTION OF LOCALITIES FOR DAY 2

Localities for Day 2 are shown on figure 21. All localities will be reached by boat on Lake Cumberland.

OWENS BRANCH

At this locality (OB, fig. 21) we will examine the spectacular bluffs on both sides of a cul-de-sac on the eastern side of the Indian Creek arm of Lake Cumberland. Cumberland City 7.5-minute quadrangle, Clinton County, Kentucky (1600 FWL, 2800 FNL, sec. 12, D-53).

Outcrops along the shores of the cul-de-sac, the shores of Indian Creek, and westward toward Seventy-six Falls expose an extensive wackestone-buildup complex (fig. 9B). At Owens Branch, the maximum measured thickness of the wackestone buildup facies was 14 m. Like other wackestone buildups in the Fort Payne, the Owens Branch buildup has a green-shale mound beneath it; the carbonates reach maximum thickness on the flanks of the shale mound and thin over its crest. Also, a coarse crinoidal packstone up to 50 cm thick occurs at the base of the massive wackestone. A feature well displayed here is undulation of the buildup carbonates as they thin toward the periphery of the buildup.

TABLE 6 — *Faunal list from the sheetlike-packstone facies at the Wolf Creek/Caney Creek locality.*

CRINOIDS

MONOBATHRID CAMERATES
Abatocrinus grandis
Actinocrinites sp. "nonlobate"
Agaricocrinus spp.
Alloprosallocrinus conicus
Eretmocrinus magnificus
Eretmocrinus praegravis
Eretmocrinus ramulosus
Eucladocrinus millebrachiatus
Macrocrinus sp.
Paradichocrinus planus
Platycrinites hemisphaericus
Uperocrinus nashvillae
Uperocrinus robustus

DISPARIDS
Halysiocrinus tunicatus
Synbathocrinus swallovi

PRIMITIVE CLADIDS
Barycrinus sculptilis
Barycrinus stellatus
Barycrinus spurius
Cyathocrinites spp.

ADVANCED CLADIDS
Adv. cladid primitive grade A

FLEXIBLES
Mespilocrinus romingeri

BLASTOIDS

Deliablastus tribulosus

OTHER FAUNAL ELEMENTS

SPONGES
?calcareous sponges

COELENTERATA
Cladochonus beecheri
Trochophyllum verneuilanum

CYSTOPORATE BRYOZOA
Cheilotrypa sp.
Cystodictya spp.

FENESTRATE BRYOZOA
Fenestella spp. [sensu lato]

CRYPTOSTOME BRYOZOA
Saffordotaxis incrassata

STROPHOMENID BRACHIOPODS
Rugosochonetes planumbona
misc. productids

SPIRIFERID BRACHIOPODS
Brachythyris suborbicularis
Unispirifer? floydensis?

ATRYPID BRACHIOPODS
Cleiothyridina parvirostra

GASTROPODS
Platyceras (Orthonychia) acutirostre
Platyceras (Platyceras) equilateralis

BIVALVES
Cypricardinia scitula

ANNELIDA
Spirorbis sp.

CONODONTA
Idioprioniodus sp.

VERTEBRATA
misc. bone

TABLE 7 — *Faunal list from the channelform-packstone facies at the Wolf Creek South locality.*

CRINOIDS

DIPLOBATHRID CAMERATES
Gilbertsocrinus tuberosus

MONOBATHRID CAMERATES
Platycrinites hemisphaericus

PRIMITIVE CLADIDS
Barycrinus spp.
Cyathocrinites spp.

ADVANCED CLADIDS
?*Cydrocrinus concinnus*
Hypselocrinus sp.
?*Decadocrinus depressus*
Pelecocrinus sp.

BLASTOIDS

Deliablastus cumberlandensis

OTHER FAUNAL ELEMENTS

SPONGES
siliceous sponge spicules

CONODONTA
Gnathodus sp. cf. *G. typicus*
Idioprioniodus sp.

VERTEBRATA
palaeoniscoid fish teeth
misc. bone

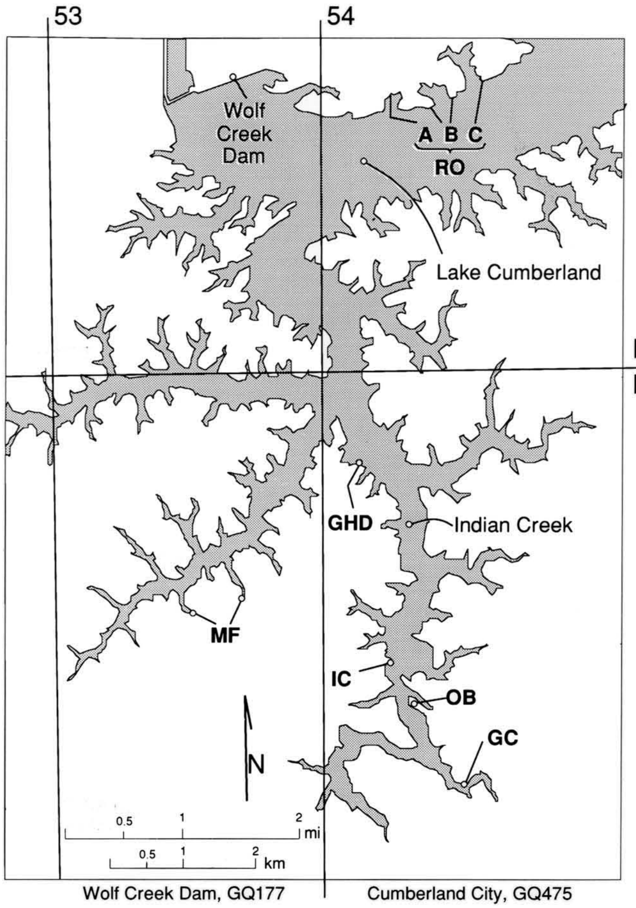

Figure 21. Detailed map of localities for Day 2 (area B of fig. 1), Cumberland City and Wolf Creek Dam 7.5-minute quadrangles, Kentucky. GC, Gross Creek; GHD, Grider Hill Dock; IC, Indian Creek; MF, Middle Fork buildup; OB, Owens Branch; RO, Rowena buildup. GQ numbers are the numbers of the U.S. Geological Survey Geologic Quadrangle Series maps. Divisions D, E, 53, and 54 are Carter Coordinate grids.

This undulation occurs in most other wackestone buildups and has been a particularly baffling feature. The wackestone buildup facies is transected on both sides of Indian Creek immediately west of Owens Branch, and is traceable westward toward Seventy-six Falls (figs. 22, 23).

Table 8 lists the fauna from Owens Branch. The crinoid component from the carbonates is similar to that of other wackestone mounds in the Fort Payne (fig. 11). The list includes some taxa that are restricted to the green shale, such as *Gaulocrinus* spp. and the blastoids *Granatocrinus granulatus* and *Deliablastus cumberlandensis*. Preservation of crinoids in the wackestone mound generally ranges from disarticulated plates to complete calyxes. A few specimens with arms or stalk attached have been found. In place holdfasts also have been found in the mound facies.

GROSS CREEK

This locality (GC, fig. 21) lies along the shores of Gross Creek, a tributary to Indian Creek, Lake Cumberland. Cumberland City 7.5-minute quadrangle, Clinton County, Kentucky (1000 WEL, 500 SNL, sec. 19, D-53).

Gross Creek is a crinoidal-packstone buildup comparable in lithofacies and faunal composition to the Cave Springs locality. Lateral tracing of the beds at Gross Creek toward the Owens Branch buildup shows that the Gross Creek beds lie above the Owens Branch complex. Thin-bedded crinoidal packstones and interbedded green shales along the shores of Gross Creek contain a diverse, abundant, well-preserved echinoderm fauna (table 9). Echinoderm preservation covers the entire spectrum, including specimens with arms and stalk attached. In addition, this locality produces numerous in place holdfasts.

INDIAN CREEK

This locality (IC, fig. 21) is on the peninsula extending from the western shore of Indian Creek, 0.4 mile south of a power line crossing and 0.3 mile north of Owens Branch. Cumberland City 7.5-minute quadrangle, Clinton County, Kentucky (1200 EWL, 700 SNL, sec. 12, D-53).

This locality presents a superb example of the sheetlike crinoidal packstone facies, comparable to Wolf Creek/Caney Creek, but better developed. A massive, cross-bedded, fining-upward carbonate unit occurs within "background" siltstones and shales. Notable features are the undulatory basal contact with underlying siltstones, variations in thickness, low-angle cross-bedding, and smooth upper surface. A coarse accumulation of disarticulated crinoidal material occurs at the bases of the thickened, troughlike intervals. Some crinoid calyxes without arms or stalk are present, as are holdfasts that appear to have been transported. Although we have not yet conducted a detailed analysis of this outcrop, the massive, graded unit appears to represent a single depositional unit, perhaps a single carbonate turbidite or debris flow.

ROWENA

This locality (RO, fig. 21) includes exposures on headlands and embayments 1.8-2.6 miles east of Wolf Creek Dam on the northern shore of Lake Cumberland, south of the hamlet of Rowena. Cumberland City 7.5-minute quadrangle, Russell County, Kentucky (S 1/2 sec. 12, E-53).

This series of outcrops exposes the flanks of a wackestone buildup, although the crest may lie to the north beneath the valley slopes. We have not yet studied these outcrops in detail, but they present some features of the mud-mound facies that are not displayed elsewhere. At site A (fig. 21),

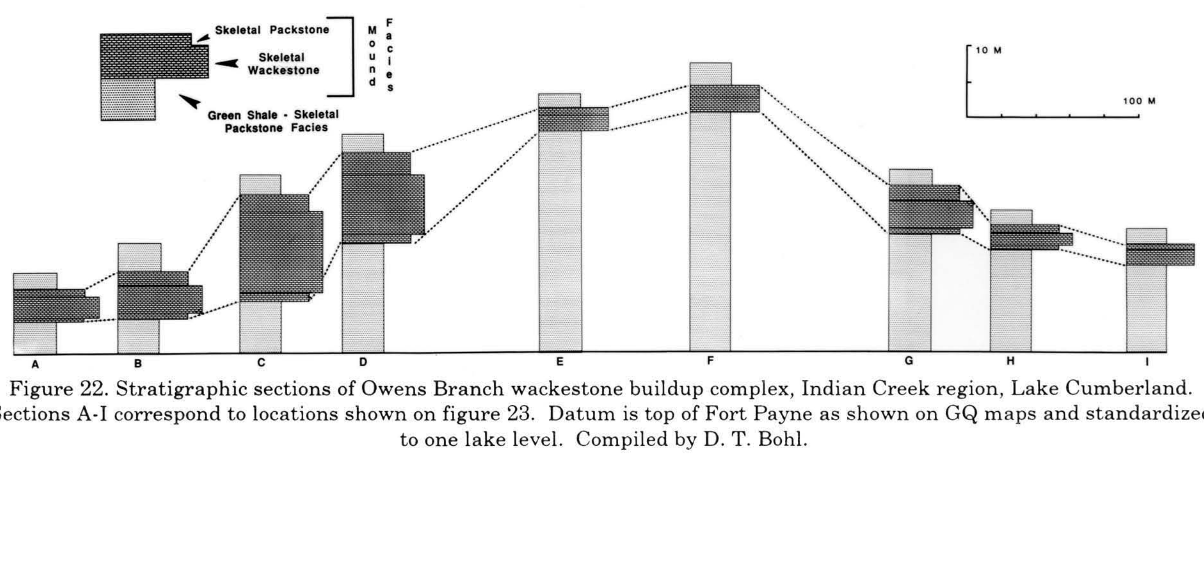

Figure 22. Stratigraphic sections of Owens Branch wackestone buildup complex, Indian Creek region, Lake Cumberland. Sections A-I correspond to locations shown on figure 23. Datum is top of Fort Payne as shown on GQ maps and standardized to one lake level. Compiled by D. T. Bohl.

TABLE 8 — *Faunal list from wackestone-buildup facies at Owens Branch.*

CRINOIDS

DIPLOBATHRID CAMERATES
Gilbertsocrinus tuberosus

MONOBATHRID CAMERATES
Abatocrinus grandis
Actinocrinites sp. "lobate"
Agaricocrinus spp.
Alloprosallocrinus conicus
Eretmocrinus magnificus
Eretmocrinus praegravis
Eretmocrinus ramulosus
Eucladocrinus millebrachiatus
Macrocrinus sp.
Uperocrinus nashvillae
Uperocrinus robustus

DISPARIDS
Catillocrinus tennesseeae
Halysiocrinus tunicatus
Halysiocrinus sp.
Synbathocrinus swallovi

PRIMITIVE CLADIDS
Barycrinus sculptilis
Barycrinus spurius
Barycrinus stellatus
Cyathocrinites spp.

ADVANCED CLADIDS
Adinocrinus sp.
Atelestocrinus sp.
?Holcocrinus sp.
Scytalocrinus decadactylus
adv. cladid primitive grade C
adv. cladid advanced grade C
adv. cladid advanced grade D

FLEXIBLES
Gaulocrinus symmetros
Gaulocrinus veryi

BLASTOIDS

Deliablastus cumberlandensis
Dentiblastus macurdai
Granatocrinus granulatus
Hadroblastus breimeri
Metablastus wortheni
Xyeleblastus magnificus

OTHER FAUNAL ELEMENTS

COELENTERATA
Amplexizaphrentis sp.
Amplexus sp.
Trochophyllum verneuilanum

CYSTOPORATE BRYOZOA
Cystodictya spp.

FENESTRATE BRYOZOA
Fenestella spp. [sensu lato]

ORTHID BRACHIOPODS
Rhipidomella oweni

STROPHOMENID BRACHIOPODS
Echinoconchus alternatus

SPIRIFERID BRACHIOPODS
Brachythyris suborbicularis
Imbrexia montgomeryensis
Tylothyris sp.
Unispirifer? floydensis?

ATRYPID BRACHIOPODS
Actinoconchus lamellosus
Cleiothyridina parvirostra

GASTROPODS
Platyceras (Orthonychia) acutirostre
Platyceras (Platyceras) equilateralis
unidentified high-spired gastropod

OPHIUROIDS
misc. ophiuroids

TABLE 9 — *Faunal list from the crinoid-packstone-buildup facies at Gross Creek.*

CRINOIDS

DIPLOBATHRID CAMERATES
Gilbertsocrinus tuberosus

MONOBATHRID CAMERATES
Abatocrinus grandis
Abatocrinus stereopes
Abatocrinus sp.
Actinocrinites sp. "nonlobate"
Agaricocrinus spp.
Alloprosallocrinus conicus
Dorycrinus gouldi
Eretmocrinus magnificus
Eretmocrinus praegravis
Eretmocrinus ramulosus
Eretmocrinus sp.
Eucladocrinus millebrachiatus
Macrocrinus sp.
Paradichocrinus planus
Platycrinites hemisphaericus
Uperocrinus nashvillae
Uperocrinus robustus

DISPARIDS
Halysiocrinus tunicatus
Halysiocrinus sp.
Synbathocrinus swallovi

PRIMITIVE CLADIDS
Barycrinus sculptilis
Barycrinus stellatus
Cyathocrinites spp.

ADVANCED CLADIDS
Holcocrinus spp.
?Holcocrinus sp.
Scytalocrinus decadactylus
adv. cladid advanced grade B

FLEXIBLES
Nipterocrinus monroensis

BLASTOIDS

Deliablastus cumberlandensis
Xyeleblastus magnificus

OTHER FAUNAL ELEMENTS

FORAMINIFERA
Ammodiscus? sp.

SPONGES
siliceous sponge spicules

COELENTERATA
Amplexizaphrentis sp.
Cladochonus beecheri
Cyathaxonia arcuata

SPIRIFERID BRACHIOPODS
Imbrexia montgomeryensis
Unispirifer? floydensis?

GASTROPODS
Platyceras (Platyceras) equilateralis

ECHINOIDS
misc. echinoids

CONODONTA
Gnathodus texanus
Gnathodus sp. cf. *G. typicus* morph 2
misc. conodonts

VERTEBRATA
palaeoniscoid fish teeth
misc. bone

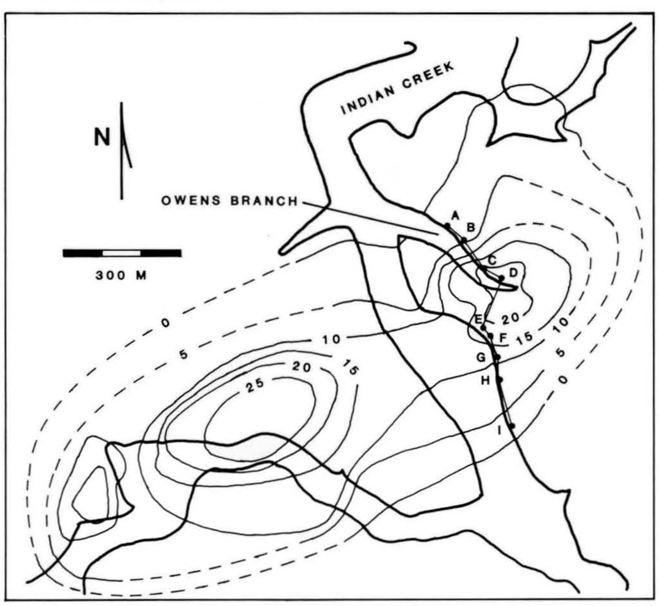

Figure 23. Isopach map of Owens Branch wackestone buildup facies, Indian Creek region, Lake Cumberland. By D. T. Bohl. Isopach interval is 5 m.

massive wackestone is exposed on the northern and eastern sides of the embayment. On the northern side, there is evidence of an irregular cavity fabric within the wackestone; cavities are filled with fine, commonly laminated silt or crinoidal debris. Irregularity of the cavities and presence of angular fragments of wackestone suggest that the cavities are not burrows. The silt filling appears to have been derived from a siltstone layer immediately overlying the wackestone. To the east, at site B the Devonian Chattanooga Shale is exposed at lake levels below about 212 m (695 ft). Green shale and sheetlike packstones first appear at the base of the Fort Payne, and the wackestone-mound facies lies about 6 m above the base. At site C there is an excellent exposure of undulatory crinoidal wackestones on the margins of the mud mounds. Crinoids found here include the monobathrid camerates typical of the wackestone-buildup facies (fig. 11).

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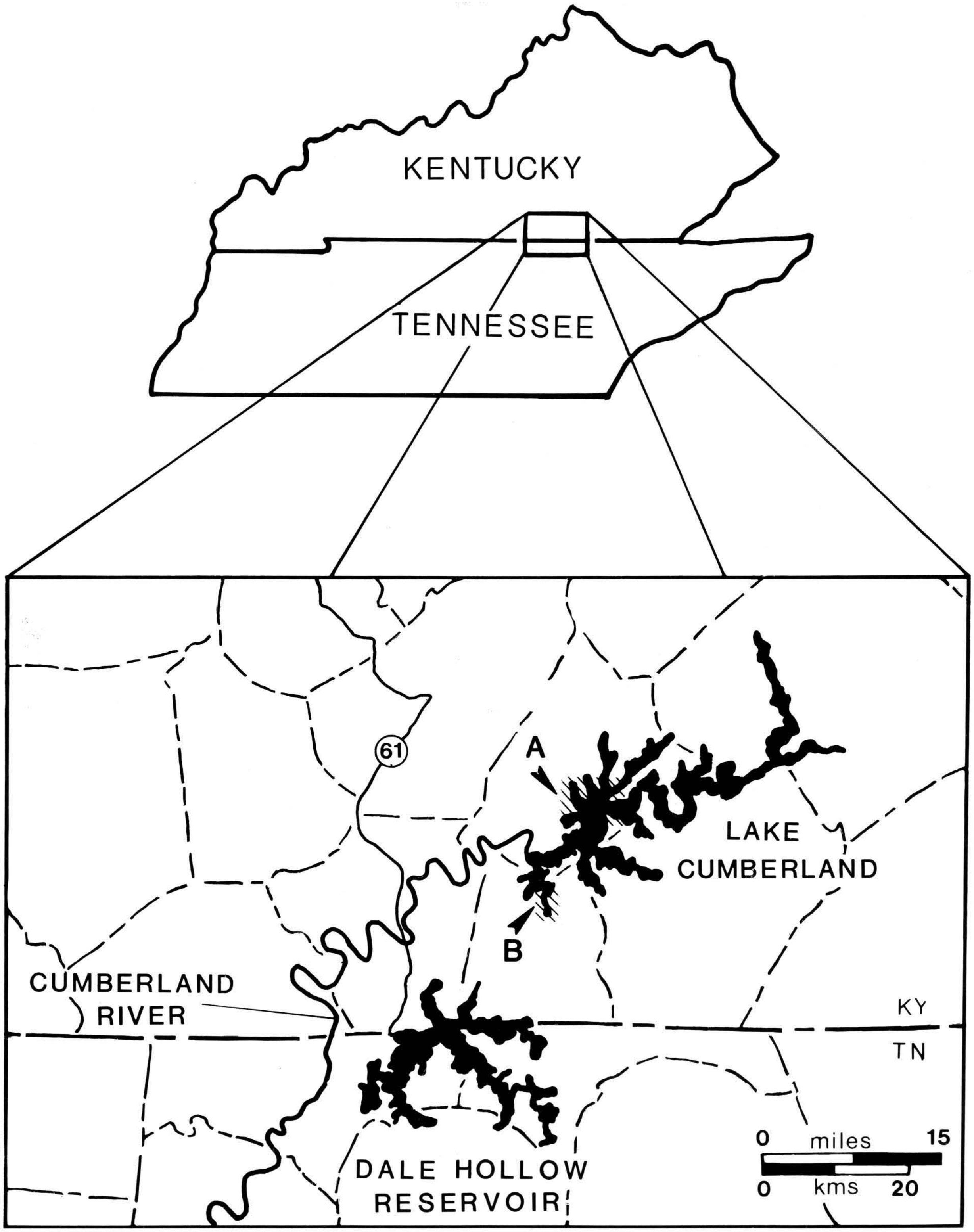

LOCATION OF FIELD-TRIP AREAS IN KENTUCKY AND TENNESSEE